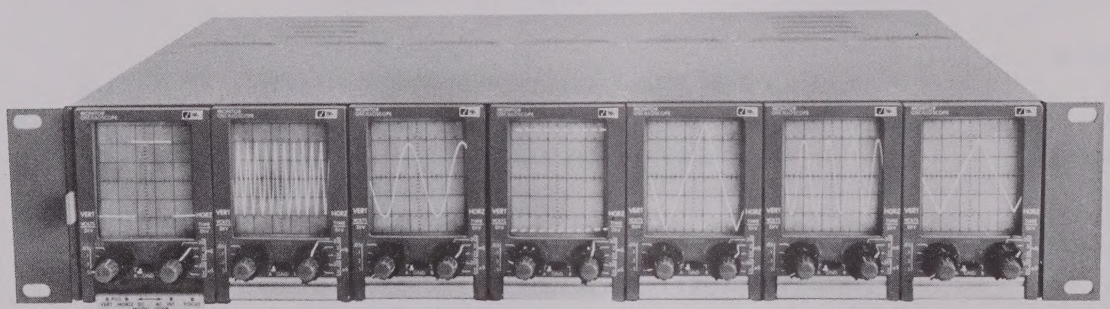
TECHNICAL MANUAL

# MONITOR OSCILLOSCOPE

## SERIES 1200

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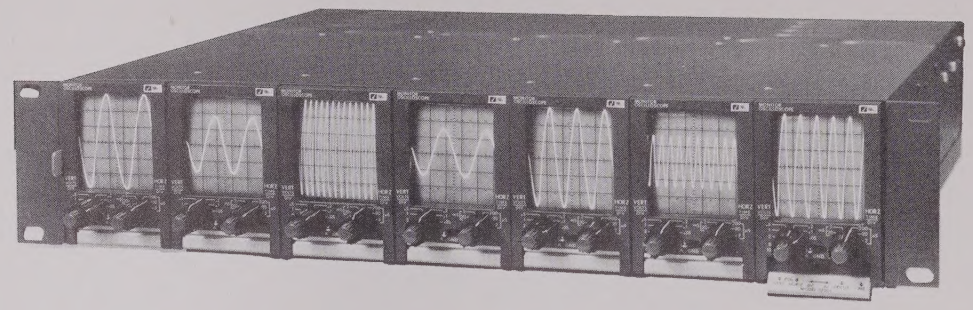
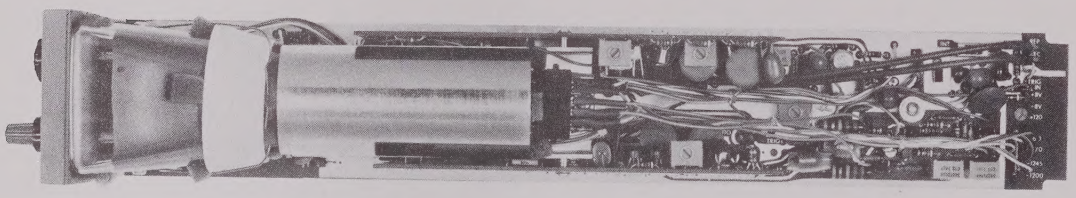
# SECTION I

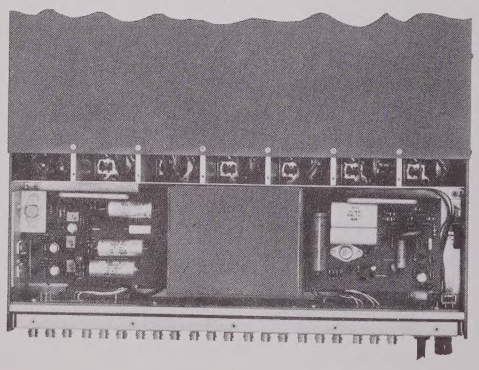
# GENERAL DESCRIPTION



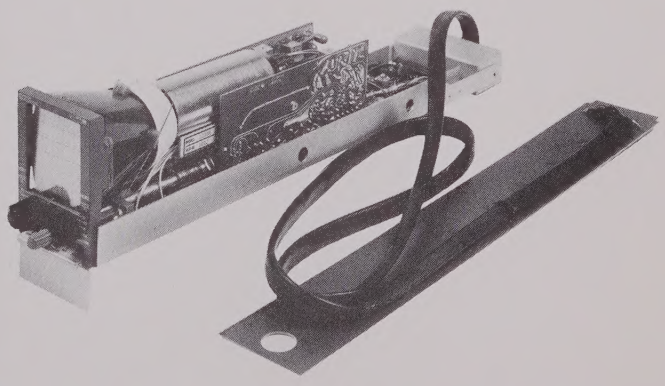
Series 1200 unit, with seven Model 1210 or Model 1220 Oscilloscope Modules plugged into Model 1201 Power Supply/Rack Chassis



Model 1210 or Model 1220 Oscilloscope Module



Model 1201 Power Supply/Rack Chassis (top rear view) showing Low Voltage and High Voltage Power Supply plug-in assemblies



Option 12002 Extender Cable Assembly with Oscilloscope Module inserted

*Figure 1-1. Series 1200 Monitor Oscilloscope*

## 1-1. INTRODUCTION

1-2. This technical manual contains complete operation, calibration and maintenance instructions for the Series 1200 Monitor Oscilloscopes.

1-3. Care should be taken to ensure this manual is employed only in conjunction with model numbers ending in a "B" suffix. The Series 1200 manual edition dated "March 19, 1973" should be used for operation, calibration and maintenance of model numbers ending in an "A" suffix.

1-4. The purpose of this manual is to provide the operation, calibration and maintenance information required by the equipment operator or service technician. The manual does not include information pertaining to special equipment application, nor does it include instructions for accomplishing repairs of the type performed at the factory.

1-5. The manual is divided into eight sections. Section I provides general information regarding the purpose of the equipment, its physical arrangement and its pertinent specifications. Section II contains information on installation and unpacking. Section III contains instructions for operating the equipment. Section IV describes the theory of operation of the equipment circuits and mechanisms. Section V provides the test, alignment and maintenance procedures. Section VI contains the complete parts list. Section VII contains complete circuit drawings. Section VIII provides the list of recommended spare parts.

**WARNING**

When performing the power supply alignment, the instrument may be operating with the top cover removed. High voltages which could be lethal are accessible and extreme caution should be taken. Only screwdrivers with insulated shafts should be used for setting the adjustments. The top cover should be removed only for the duration of time required to make the alignment. The power should be off while the cover is being removed or installed.

## 1-6. PHYSICAL DESCRIPTION

1-7. Each Series 1200 unit is a 7-channel monitor oscilloscope which utilizes modular packaging and complete plug-in construction. The instrument is composed of two Data Check models illustrated in Figure 1-1 which are: Model 1201 Power Supply/Rack Chassis, and Model 1210 or Model 1220 Oscilloscope Module. The Series 1200 Monitor Oscilloscopes can be configured with from two up to seven modules in any combination of the Models 1210 or 1220. Blank panels are available in the event less than seven oscilloscope modules are installed. Each Model 1210 or Model 1220 Oscilloscope Module is a self-contained, triggered sweep oscilloscope, with all modules powered by a common power supply included within the Model 1201 Power Supply/Rack Chassis. All basic operating

controls are located on the front panel, and all input connectors are positioned on the rear panel. Rack mounting brackets are supplied with each chassis for mounting in a standard 19 inch RETMA cabinet. The side rails of each chassis are configured to accept optional chassis slides, if required. In the absence of chassis slides, rear support for the chassis is recommended.

1-8. All active assemblies are of plug-in construction. The oscilloscope modules are extracted directly from the front panel using a handle which also serves as a trap door to conceal the trace controls. When inserted, a spring loaded detent snaps into position to secure each module firmly in place. As shown in Figure 1-1, the two low voltage and high voltage power supply assemblies plug into the top rear of the chassis; access is achieved by removing the top rear chassis cover, the screws for which can be reached from the front of the unit when the chassis is mounted on chassis slides. The two power supply assemblies can be serviced without the necessity for removal from the chassis. Each oscilloscope module is serviced by using the Extender Cable Assembly shown in Figure 1-1. Detailed information on Models 1201 and 1210/1220 follows in paragraphs 1-10 and 1-14, respectively. Further information concerning the optional Blank Panel, Chassis Slides and Extender Cable Assembly is included in paragraph 1-18.

1-9. Table 1-1 is a tabulation of all major components in the Series 1200 Monitor Oscilloscopes.

| MODEL NO. | ASSEMBLY NO. OR P/N | DESCRIPTION | TABLE |
|---|---|---|---|
| 1201 | ------ | Power Supply/Rack Chassis (complete) | 6-16 thru 6-23 |
| -- | 12015006 | Low Voltage Power Supply Assembly | 6-18 |
| -- | 12015007 | High Voltage Power Supply Assembly | 6-19 |
| -- | P/N 7-61007 | Power Transformer | 6-21 |
| 1210 | 12105034 | Oscilloscope Module (complete) | 6-13 |
| 1220 | 12105035 | Oscilloscope Module (complete) | 6-5 |
| -- | 12105033 | 1210/1220 Horizontal Assembly | 6-8 |
| -- | 12105032 | 1210 Vertical Assembly | 6-15 |
| -- | 12105031 | 1220 Vertical Assembly | 6-7 |
| -- | P/N 3-40002 | CRT | 6-10 |

*Table 1-1. Major Components Series 1200*

## 1-10. MODEL 1201 POWER SUPPLY/RACK CHASSIS

1-11. The Model 1201 Power Supply/Rack Chassis consists of an all steel chassis with machined metal board guides which accept the oscilloscope modules and a power supply section that provides the necessary power supply voltages for each of the oscilloscope modules. The board guides insure a positive mating of the gold plated oscilloscope module connectors with the master board receptacles. The connectors utilized on the master board are also channeled to guide each assembly connector into correct position prior to contact. This method of construction allows for removal and replacement of any oscilloscope module without having to remove the chassis from the system cabinet.

1-12. The master board used in the Model 1201 is a plated through printed circuit board with nine printed circuit connectors. Two of these connectors mate with the two plug-in power supplies and etch circuitry distributes the necessary voltages to the other seven connectors which are used for the modules. This method reduces hand wiring to the input signal coaxial cables and increases the reliability as well as the ease of maintenance. Due to low power dissipation of an all solid state design, no cooling fan is required. This contributes to greater effectiveness in reducing system EMI problems. The Model 1201 front panel contains the power switch. The input signal display channels are 1 through 7 reading from left to right when facing the instrument.

1-13. The signal input BNC connectors for each of up to seven oscilloscope modules are contained on the rear panel in addition to the power cable and AC line fuse. Three input connectors are included for each oscilloscope module channel. These are: (1) "A" vertical input, or REC (record), (2) "B" vertical input, or REP (reproduce), and (3) external trigger input.

## 1-14. MODELS 1210 and 1220 OSCILLOSCOPE MODULES

1-15. Both models of the oscilloscope module are constructed on a single printed circuit board with vertical circuit and horizontal circuit plug-in assemblies to facilitate ease of calibration and maintenance. Integrated circuits, silicon semiconductors and tantalum capacitors are used exclusively. The printed circuit boards have their principle components identified by reference designators, and all diodes and tantalum capacitors are identified for polarity. Key power supply voltage are also identified.

1-16. All of the basic controls required by the operator during use are located on the front panel of each oscilloscope module. These controls include:

1. Input Selector (select A (REC) or B (REP) vertical signal inputs).
2. AC/DC Coupling.
3. Vertical Sensitivity Selector.
4. X10 Vernier (vertical sensitivity).
5. Vertical Position.
6. Horizontal Sweep Selector.
7. X10 Vernier (horizontal sweep rate).

8. Horizontal Position.

9. Intensity.

10. Focus.

Additional, seldom used controls are included within each oscilloscope module. These include:

11. Trace Angle (access through forward section of chassis bottom cover).

12. Astigmatism.

13. Trigger Source.

14. Trigger Slope.

15. Trigger Mode (optional; see paragraph 1-19).

A trap door located beneath the vertical and horizontal range switches tilts down to expose the position, focus, intensity, and, for the 1220 module, AC/DC coupling controls. This door also serves as a handle to extract the module. The Cathode Ray Tube is secured within a milled out area behind the front panel, thus bringing the display closer to the front panel to enhance ease of viewing. A photo positive graticule made on clear mylar is inserted in the milled area between the CRT and the front panel. This eliminates the problem of realigning new CRT's when replacement is required. This milled out area can also be utilized for the use of a filter by moving the CRT slightly to the rear and inserting the filter between the CRT face plate and the graticule.

1-17. All of the active circuitry within the Series 1200 Oscilloscopes is contained on only five different plug-in printed circuit assemblies. These include the oscilloscope module with its vertical circuit and horizontal circuit plug-in assemblies, as well as low voltage and high voltage power supply assemblies. They are also available and conveniently packaged as a spare parts kit for use in trouble shooting and maintaining a Series 1200 unit in remote field locations over long time periods.

## 1-18. OPTIONS AND ACCESSORIES

1-19. The Series 1200 Monitor Oscilloscopes include several options and accessories in addition to the basic models described in paragraphs 1-10 through 1-17. These are available to the user to enhance his application and/or facilitate maintenance of every unit. Options and accessories included are:

1. Option 12001 Blank Panel — for use in Model 1201 Power Supply/Rack Chassis slots which do not include a Model 1210 or a Model 1220 Oscilloscope Module.

2. Option 12002 Extender Cable Assembly — for use in calibration and maintenance of the Models 1210 or 1220 Oscilloscope Modules. This assembly includes a chassis into which the oscilloscope module is inserted for calibration in order to duplicate the circuit etch to metal environment which the module experiences within the Model 1201 Power Supply/Rack Chassis. This chassis has a swing-out bottom panel for access to the underside of the oscilloscope moduel master printed circuit (P/C) board. The chassis is connected to a connector P/C board (via a harness cable) which is inserted into the normal module slot for input signal and power supplies access.

3. Option 12004 Chassis Slides.

4. Option 12005 Trigger Mode – this feature includes a slide switch located on the oscilloscope module master P/C board which, when properly positioned, disables the standard automatic trigger feature and allows the user to trigger the sweep from a broader class of signal waveforms. These include signals with a frequency less than the automatic trigger rate of approximately 10 Hz, and signals with a duty cycle of other than 50%.

5. Spare Parts Kit – comprised of all active assemblies within a Series 1200 Monitor Oscilloscope, including one Model 1210 or Model 1220 Oscilloscope Module, one low voltage power supply assembly, and one high voltage power supply assembly.

## 1-20. OTHER SERIES 1200 MODELS

1-21. Data Check Corporation is continually developing additional versions of the Series 1200 Monitor Oscilloscope to encompass a broader area of user applications. As these models become available, complete operation, calibration and maintenance instructions for them will be included within this manual as supplements at time of delivery. Current additional versions now available include external sweep, and master/slave units.

## 1-22. APPLICATIONS

1-23. The seven channel "in-line" configuration of the Model 1200 with its Model 1210 oscilloscope modules makes it ideally suited for instrumentation magnetic tape recorder/reproducer applications where continuous, simultaneous signal monitor is essential to insure successful data collection. It guards against data loss and the excessive cost necessary to regain it by performing three basic functions:

1. Facilitates setup of the record/reproduce electronics to enable proper recording.

2. While recording, the Model 1200 provides continuous, simultaneous monitor of all record tracks so the operator can be alerted to the loss of a signal and take immediate corrective action.

3. The reproduce tracks can be monitored by switching the Model 1210 input selectors to the REP position for reproduce verification and on-site analysis of all data recorded after test. Figure 1-2 shows a typical instrumentation magnetic tape recorder application.

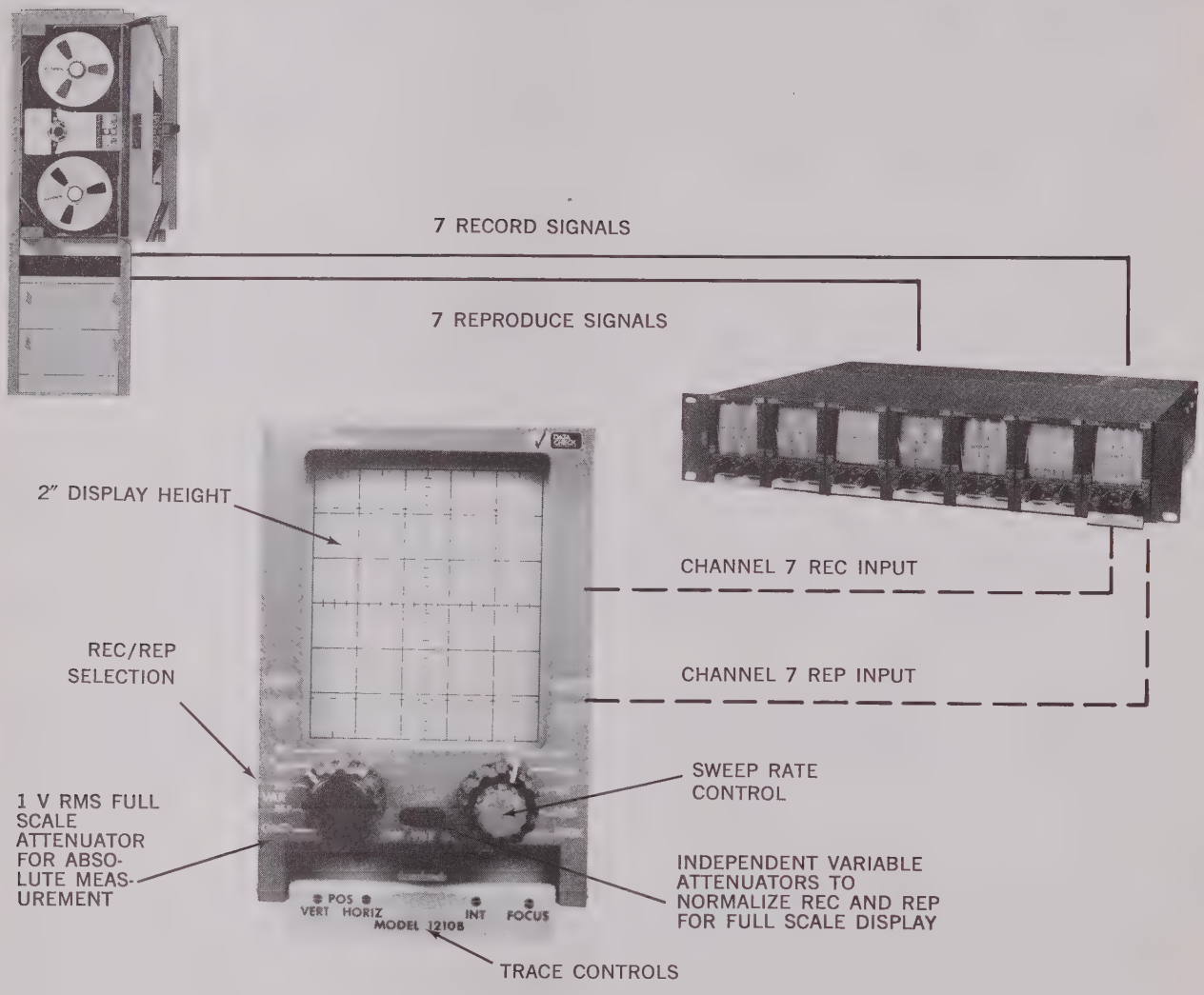



*Figure 1-2. Typical Instrumentation Magnetic Tape Recorder Application*

1-24. The multi-channel in line display capability offered by the Model 1200 Oscilloscope makes it ideally suited for real time monitor applications where simultaneous display of several signals is desirable to guarantee optimum performance or facilitate analysis. The self-contained vertical and horizontal control circuitry associated with each Model 1220 allows a given signal to be analyzed without distrubing the displays of the remaining signals. As the diagram in Figure 1-3 of a typical application shows, a total of seven dual input channels are provided, thus allowing up to fourteen analog or digital signals to be monitored, seven at a time.

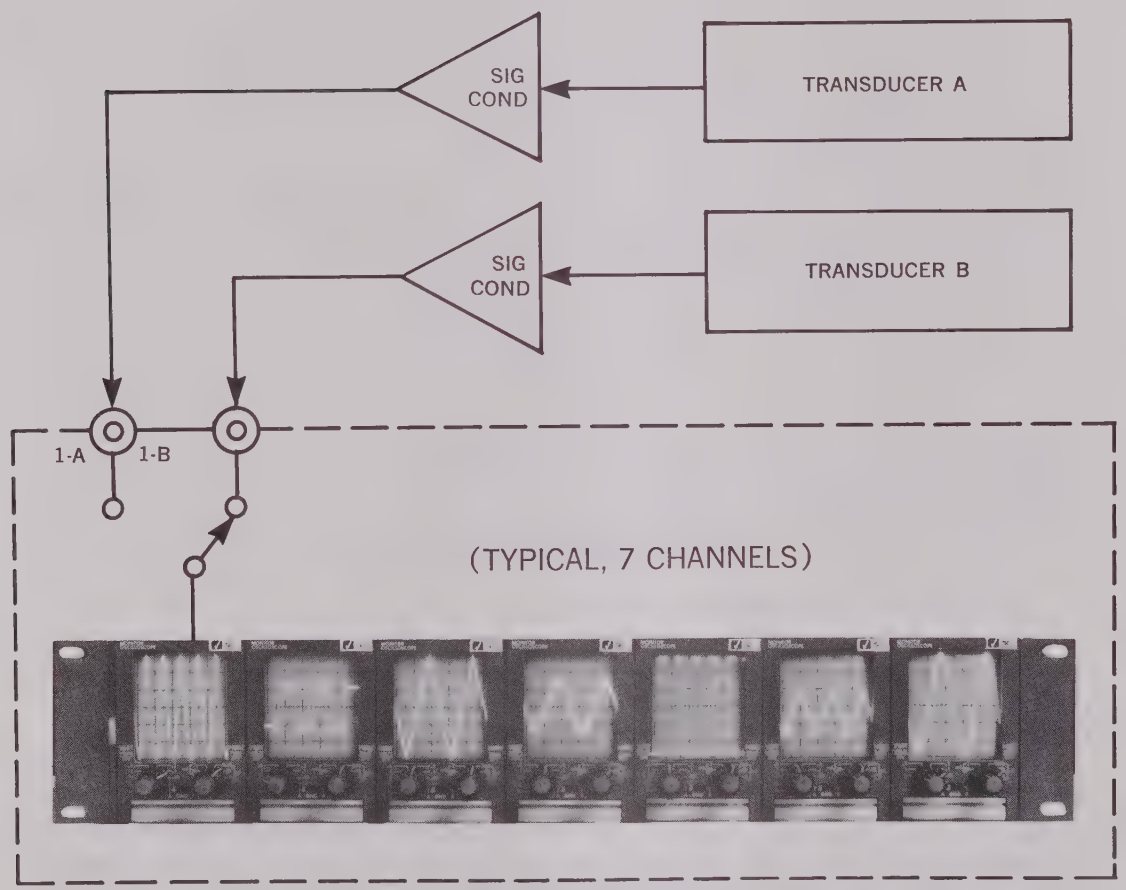



*Figure 1-3. Typical Real Time Monitor Application*

## 1-25. SPECIFICATIONS

### VERTICAL DEFLECTION

| | |
|---|---|
| BANDWIDTH: | DC to 2.5 MHz within 1dB; DC to 5 MHz within 3dB; usable beyond 10 MHz. |
| COUPLING: | AC and DC selectable for either of two inputs, or Ground. |
| DEFLECTION FACTOR – | |
| 1210: | Each of two inputs has a front panel mounted 15 turn variable gain control, adjustable from 250 mV RMS full scale to 10V RMS full scale. In addition, a selectable 1 V RMS full scale fixed attenuator range is provided for absolute measurements; may be set to any value from 250 mV RMS full scale to 10V RMS full scale (or p-p equivalents) by internal calibration adjustment. |
| 1220: | 50 mV p-p/div to 10V p-p/div in 8 calibrated ranges, 1-2-5 sequence. Vernier: Continuously variable between ranges; extends maximum delfection factor to approximately 25 V p-p/div. |
| ACCURACY: | All ranges accurate to within 3% of full scale with vernier (if applicable) in Calibrate position. |
| INPUT R AND C: | 1 megohm within 2% paralleled by less than 100 pF. |
| DC STABILITY: | Drift less than 2% of full scale upon application of power. No detectable drift after five minutes warm up. |

### HORIZONTAL DEFLECTION

| | |
|---|---|
| TIME BASE – | |
| 1210: | 10 Hz full scale to 100 KHz full scale in 5 calibrated decade ranges. Vernier: Continuously variable between ranges (X1 to X10, uncalibrated); extends maximum sweep rate to 1 MHz full scale. |
| 1220: | 2 usec/div to 20 msec/div in 5 calibrated decade ranges. Vernier: Continuously variable between ranges (X1 to X10, uncalibrated); extends maximum sweep rate to 200 nsec/div. |
| ACCURACY: | All ranges accurate to within 3% of full scale with vernier in Calibrate position. |

LINEARITY: Within 3% of full scale.

## TRIGGER

MODE: Automatic from approximately 10 Hz to beyond 5 MHz. Option 12005 allows automatic trigger to be disabled by internal slide switch mounted on oscilloscope module master printed circuit board so that the sweep can be triggered by a signal whose frequency is less than 10 Hz or more effectively by a signal of other than 50% duty cycle.

SOURCE: Internal trigger and external trigger, selectable by slide switch mounted internally on oscilloscope module printed circuit board.

SLOPE: Both positive and negative slope selection for internal as well as external trigger provided; selectable by slide switch mounted internally on oscilloscope module printed circuit board.

AMPLITUDE REQUIREMENTS: 0.5 div vertical deflection for internal trigger, or 500 mV for external trigger. Trigger sensitivity reduced to 1.0 div for internal trigger and 1.0 V for external trigger when automatic trigger disabled using Option 12005.

## CRT

CRT: 3-inch diagonal rectangular CRT is employed; mounted with longer dimension in vertical plane, thus providing approximately 2 full inches of vertical display height. P31 phosphor normally supplied. P7 phosphor available on request.

GRATICULE: Black, with 6 vertical div x5 horizontal div display area; each div is 1/3 inch. Vertical centerline marked in 5 minor divisions per major division; horizontal centerline marked in 4 minor divisions per major division. —3dB reference lines included.

## GENERAL

CONTROLS AND CONNECTORS—
FRONT PANEL: Oscilloscope Module: Input selector, AC/DC coupling, vertical sensitivity selector with X10 vernier, vertical position, horizontal sweep selector with X10 vernier, horizontal position, intensity and focus.

Chassis: Power on/off switch.

CHASSIS REAR PANEL: Dual vertical input signal and external trigger BNC connectors for each oscilloscope module.

| | |
|---|---|
| INTERNAL: | Internal/external trigger selector, positive/negative trigger slope selector, CRT astigmatism adjust, trigger mode (Option 12005), and trace angle. |
| OPERATING TEMPERATURE: | $0^{o}C$ to $+55^{o}C$. |
| HUMIDITY: | Will operate in up to 95% relative humidity, non-condensing. |
| POWER: | 115 VAC ±10% or 230 VAC ±10%, selected by internal switch; 50 to 400 Hz; 70 watts for power supply/rack chassis with full complement of oscilloscope modules. No cooling fan required. |
| WEIGHT: | Approximately 35 lbs (15.9 kg); add 5 lbs (2.3 kg) for shipping. |
| DIMENSIONS: | 3 1/2" H x 17" W x 15 1/2" D (8.89 cm x 43.18 cm x 39.37 cm); mountable in standard 19" RETMA rack. |

## 1-26. ORDERING INFORMATION

1-27. A tabulation of all Series 1200 Monitor Oscilloscope models, options and accessories follows. Refer to the appropriate paragraphs of this section for detailed information on each. Consult the Data Check Corporation factory directly or your local Data Check sales office for current price and delivery information.

Model 1200 Standard Monitor Oscilloscope
(includes 1 each 1201 with 7 each 1220)

Model 1200(R) Recorder Monitor Oscilloscope
(includes 1 each 1201 with 7 each 1210)

Model 1201 Power Supply/Rack Chassis
Model 1210 Oscilloscope Module
Model 1220 Oscilloscope Module
Option 12001 Blank Panel
Option 12002 Extender Cable Assembly
Option 12004 Chassis Slides
Option 12005 Trigger Mode
Spare Parts Kits – 1200 (or 1200(R))
P/N 12015006 Low Voltage Power Supply Assembly
P/N 12015007 High Voltage Power Supply Assembly

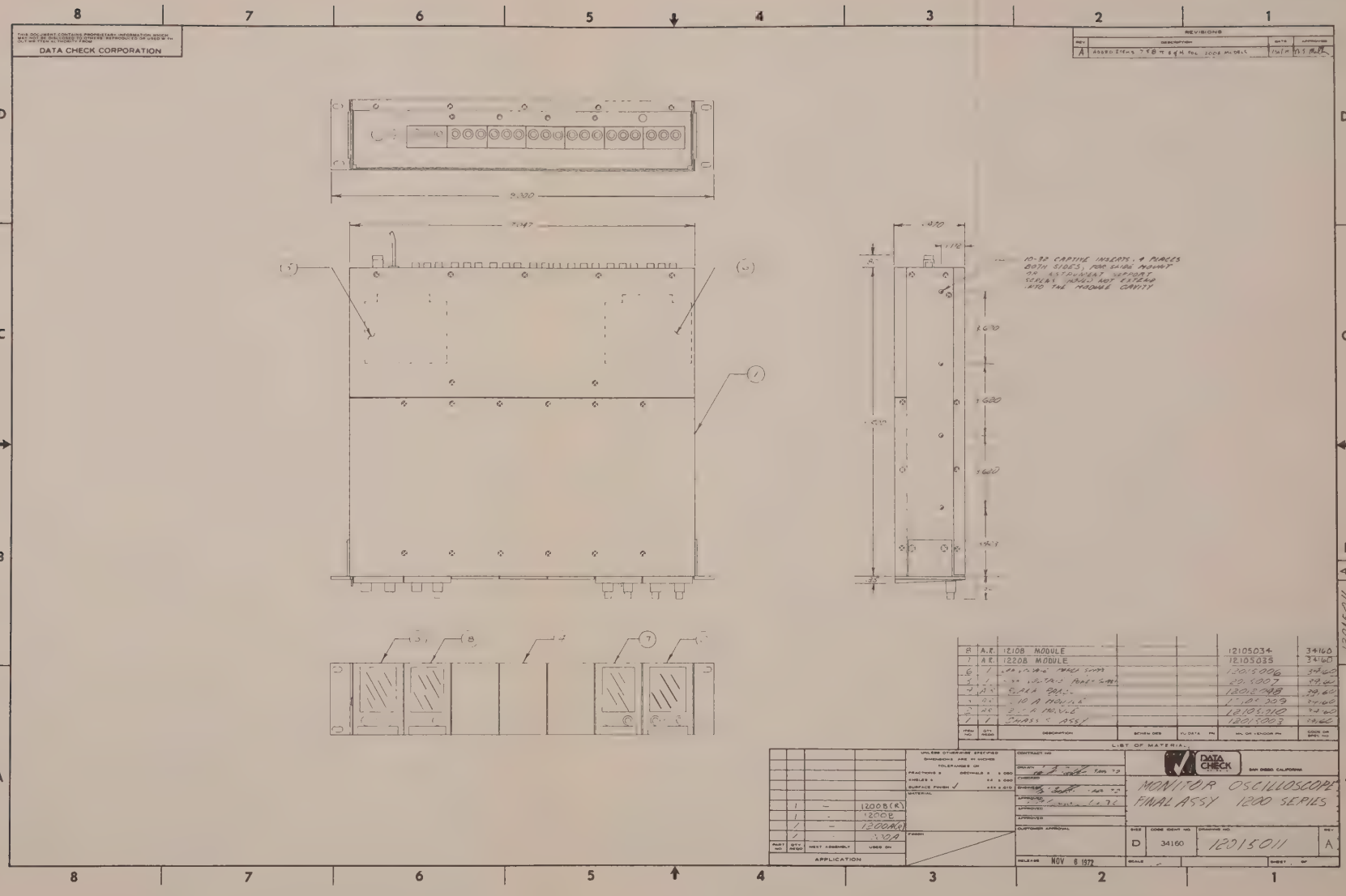

DATA CHECK CORPORATION
REVISIONS
A ADDED ITEMS 7 & 8 H. FOR 1200B MODELS
10-32 CAPTIVE INSERTS - 4 PLACES BOTH SIDES, FOR SLIDE MOUNT OR ASTRONAUT METRAK SERIES (1200) NOT USED INTO THE MODULE CAVITY
12105034 34160 12108 MODULE
12105035 34160 1220B MODULE
12015011 MONITOR OSCILLOSCOPE FINAL ASSY 1200 SERIES
NOV 6 1972

*Figure 1-4. Series 1200 Dimensional Outline Drawing*

# SECTION II

# INSTALLATION

## 2-1. INSPECTION UPON RECEIPT

2-2. The Series 1200 is aligned, calibrated, and tested under severe environmental conditions prior to shipment. The instrument is therefore ready for immediate use upon receipt. The following checks should be made however, to assure that the instrument has suffered no damage in shipment.

a. A visual inspection of the shipping container should be accomplished prior to acceptance from the carrier. If extensive damage of the shipping container is evident, a description of the damage should be noted on the carrier's receipt and signed by the carrier's agent. If damage is not apparent until the instrument is unpacked, a claim for concealed damage should be placed with the carrier within 15 days of receipt. All shipping containers and filler material must be kept for inspection.

b. A visual inspection for damage should be accomplished upon removing the instrument from the shipping container. Remove the top cover and check for loose or broken components. Remove each module and check for loose or broken components. Check to see that the printed circuit boards are mated with their connectors and are well seated.

# SECTION III

# OPERATION

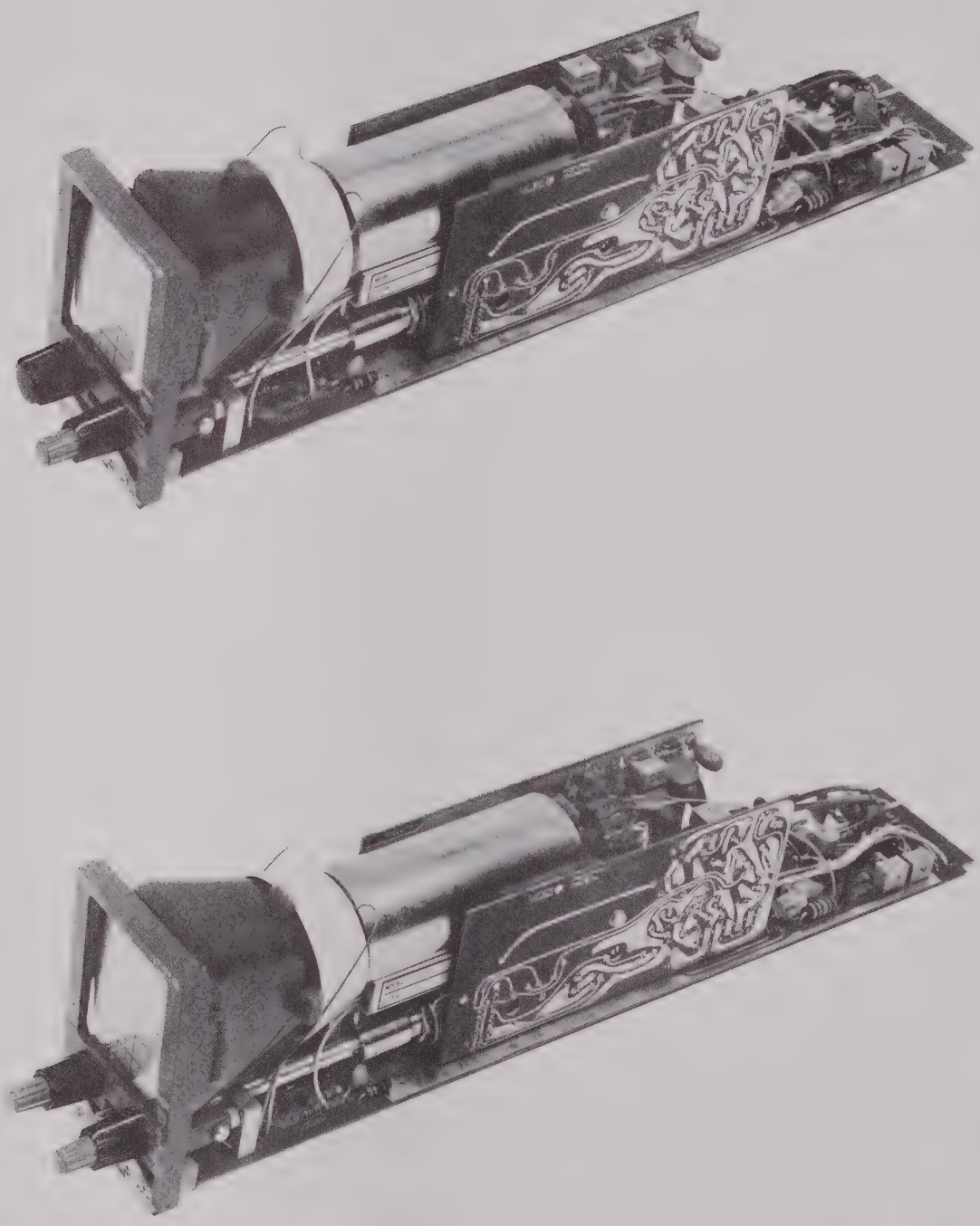


*Figure 3-1. 1210 and 1220 Modules Showing Locations of Plug-in Boards*

## 3-1. OPERATING CONTROLS

3-2. All of the controls necessary for the operation of the Series 1200 Monitor Oscilloscope are located in such a way to facilitate the ease of operation required by the operator.

3-3. The Series 1200 Monitor Oscilloscope is comprised of: (1) a rack chassis, Model 1201, which contains the power supplies, master connection PC board, and the input connectors and (2) up to seven plug-in oscilloscopes (any combination of Model 1210 or 1220). Each module consists of one main circuit board and two plug-in boards as shown in Figure 3-1. Tables 3-1 and 3-2 describe the function and location of operating controls. Figure 3-2 shows the location and appearance of the front panel controls. Figures 3-3 and 3-4 show the controls located on each module.

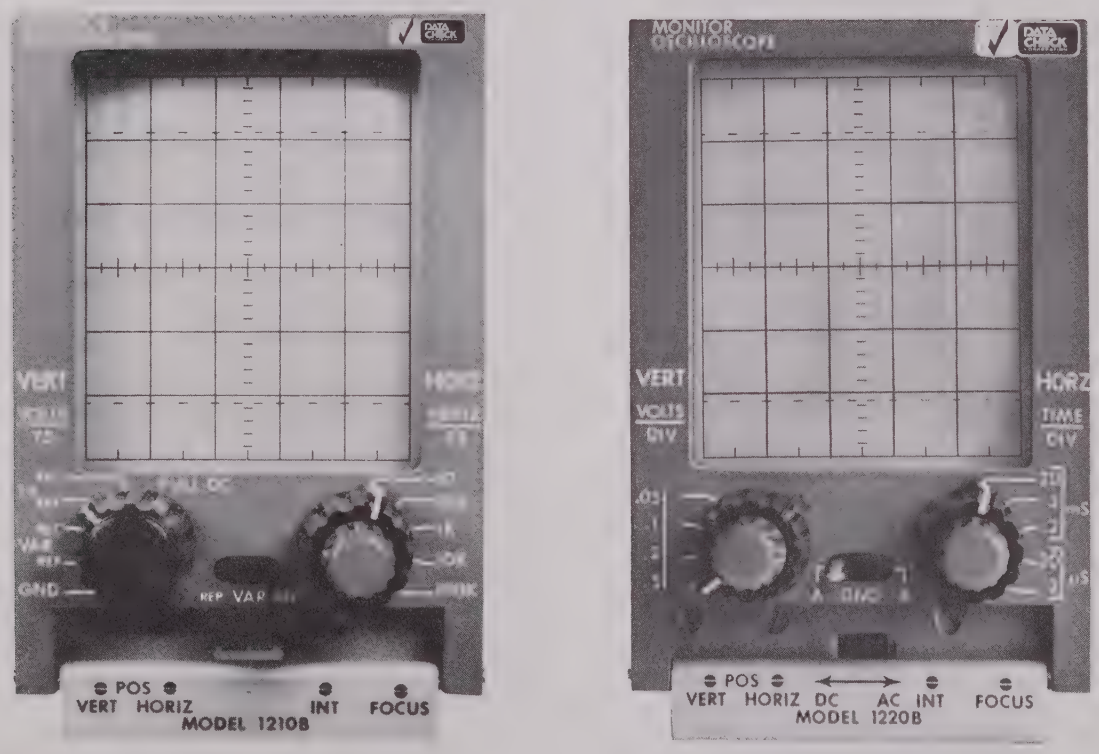



*Figure 3-2. Model 1200 Front Panels (doors down) Location and Appearance of Operating Controls*

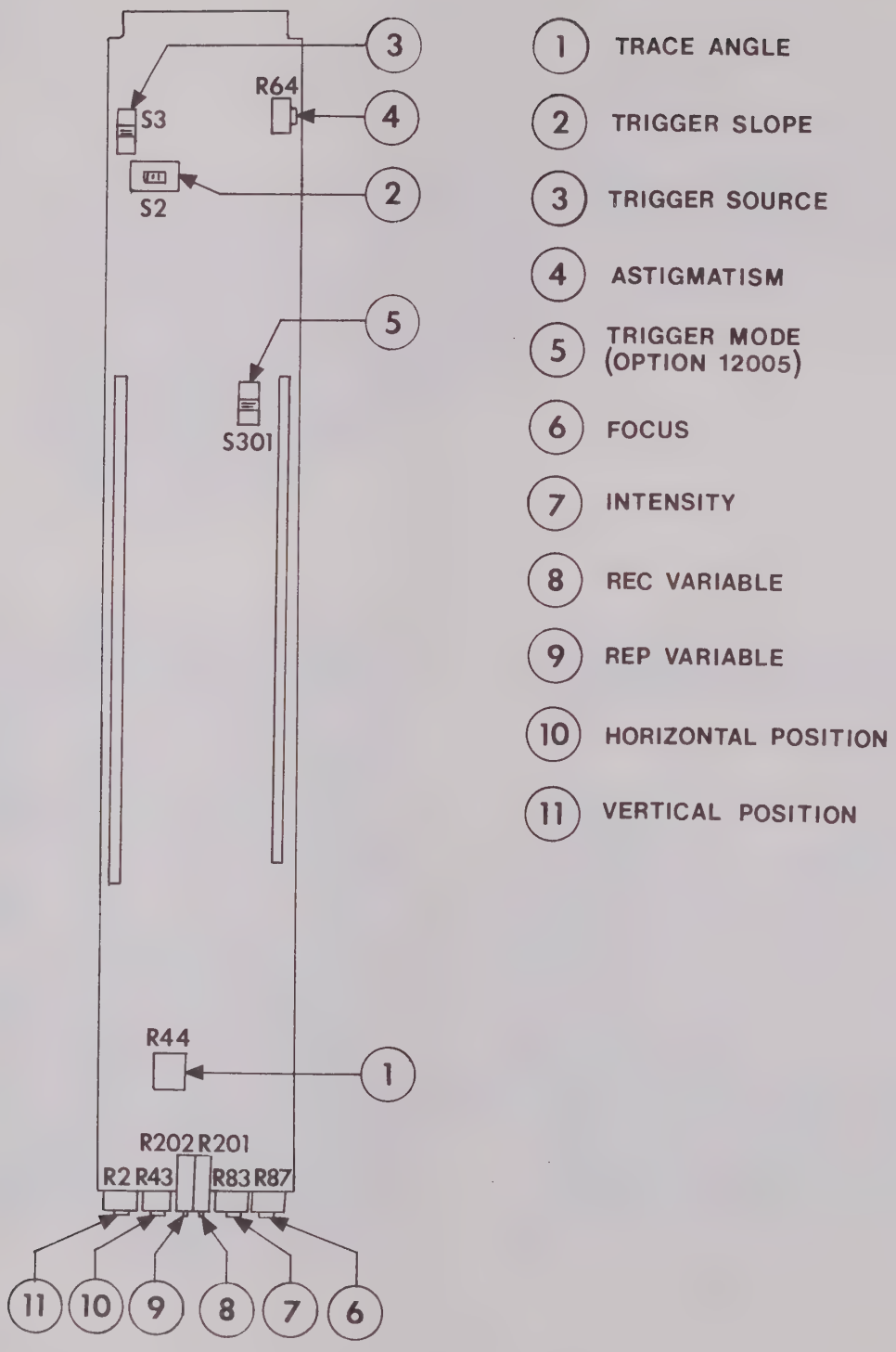



*Figure 3-3. Model 1210 Module Circuit Board Controls*

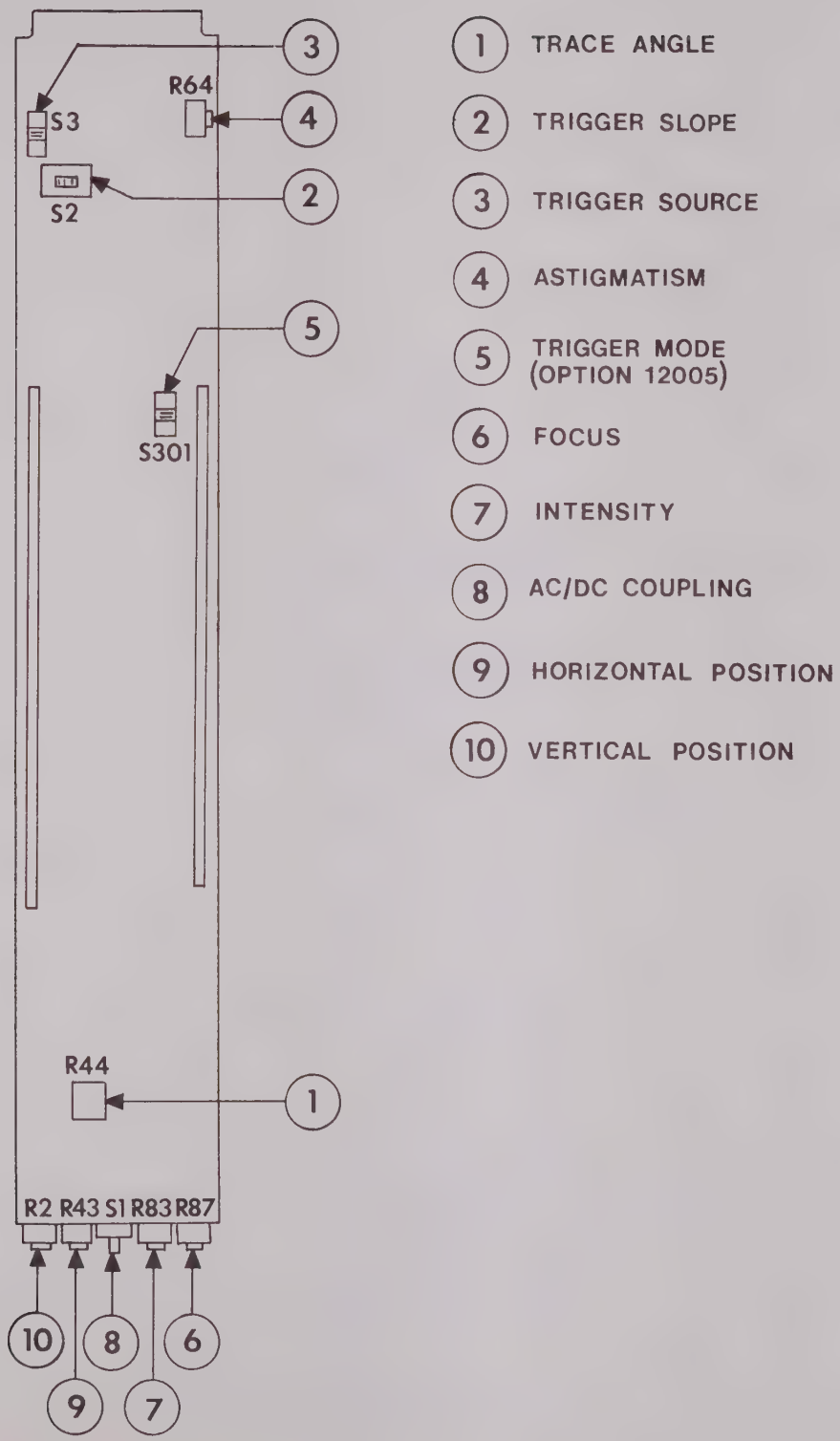



*Figure 3-4. Model 1220 Module Circuit Board Controls*

| CONTROL | POSITION | FUNCTION | LOCATION |
|---|---|---|---|
| POWER | OFF (depressed) | AC power removed | Red plastic push-push switch on left front of 1201 |
| | ON (extended) | AC power applied | |
| POWER INDICATOR | | Light indicates power on | Below power switch on front panel |
| | | 1210 CONTROLS | |
| VERTICAL VOLTS/FS (Vertical Sensitivity) | 1V REC | Input received from RECORD (A) input BNC either *AC or DC coupled and is 1V RMS Full Scale | Front Panel 1210 |
| | 1V REP | Same but from REPRODUCE or (B) input | |
| | VAR REC | Input received from RECORD (A) input BNC either *AC or DC coupled, gain adjustable by variable pot on front panel | |
| | VAR REP | Same but from REPRODUCE or (B) input | |
| | GND | The input of the module is connected to electrical ground | |
| | | *KNOB IN SELECTS AC KNOB OUT SELECTS DC | |
| AC | KNOB IN | Input Signal is AC coupled to module | Front Panel 1210 |
| DC | KNOB OUT | Input Signal is DC coupled to module | Front Panel 1210 |
| HORIZONTAL FREQ/FS (Sweep rate) | | Measures frequencies from: | Front Panel 1210 |
| | 10 | 10 Hz to 100 Hz | |
| | 100 | 100 Hz to 1 KHz | |
| | 1K | 1 KHz to 10 KHz | |
| | 10K | 10 KHz to 100 KHz | |
| | 100K | 100 KHz to 1 MHz | |

*Table 3-1. Function and Location of 1210 Operating Controls*

*Table 3-1. (Continued)*

| CONTROL | POSITION | FUNCTION | LOCATION* |
|---|---|---|---|
| X10 VERNIER RED KNOB | VAR | Continuous adjustment between each frequency range | Front Panel 1210 |
| | CAL | Cal Position is determined by KNOB FULLY CCW | |
| VERT POS. | VAR | Vertical positioning | Behind trap door on Front Panel |
| HORZ POS. | VAR | Horizontal positioning | Behind trap door on Front Panel |
| FOCUS | VAR | Focus Control | Behind trap door on Front Panel |
| INT | VAR | Intensity Control | Behind trap door on Front Panel |
| ANGLE | VAR | Trace Angle control adjusts angle of the trace on the CRT | Below module (Front Center) Adjustable thru a hole on bottom panel of 1201 |
| ASTIG | VAR | Astigmatism Control | (4) |
| TRIGGER SLOPE | + | Selects positive slope of vertical signal for sweep start | (2) |
| | – | Selects negative slope of vertical signal for sweep start | |
| TRIGGER SOURCE | INT | Module triggers from the vertical input signal | (3) |
| | EXT | Module triggers from an external signal supplied to the TRIG IN BNC on the 1201 rear panel | |
| TRIGGER MODE (Option 12005 only) | AUTO | Trigger signals are generated at approximately 10 Hz rate or synchronized to a higher frequency vertical signal. Provides a trace in the absence of a vertical signal | (5) |
| | TRIG | Disables auto oscillator. Vertical signal must be present to obtain trace | |

*Circled numbers refer to Figure 3-3.

| CONTROL | POSITION | FUNCTION | LOCATION |
|---|---|---|---|
| | | 1220 CONTROLS | |
| INPUT SELECTOR | A | The input signal to the module is received from the RECORD input located on the rear panel of the 1201 | Front Panel 1220 |
| | GRD | The input of the module is connected to the electrical ground | |
| | B | The input signal to the module is received from the REPRODUCE input located on the rear panel of the 1201 | |
| AC/DC | DC | Input signal is direct coupled to the module input | Behind trap door on front panel |
| | AC | Input signal is AC coupled to the module input | |
| VERTICAL VOLTS/DIV (Vertical Sensitivity) | KNOB BLK POS. RED<br>.05 IN<br>.1 (PUSH)<br>.2<br>.5 | <br>Input signal not attenuated .05V p-p division<br>Input signal is .1V p-p/div.<br>Input signal is .2V p-p/div.<br>Input signal is .5V p-p/div. | Front Panel 1220 BLACK KNOB |
| | BLK RED<br>1 OUT<br>2 (PULL)<br>5<br>10 | <br>Input signal is 1V p-p/div.<br>Input signal is 2V p-p/div.<br>Input signal is 5V p-p/div.<br>Input signal is 10V p-p/div. | |
| X10 VERNIER | VAR | Continuous adjustment between each amplitude range | Front Panel RED KNOB |
| | CAL | Fully CW Position | |
| | IN | Lower Vertical Sensitivity Ranges | |
| | OUT | Higher Vertical Sensitivity Ranges | |

*Table 3-2. Function and Location of 1220 Operating Controls*

*Table 3-2. (Continued)*

| CONTROL | POSITION | FUNCTION | LOCATION* |
|---|---|---|---|
| HORIZONTAL TIME/DIV (Sweep rate) | 20 ms<br>2 ms<br>200 us<br>20 us<br>2 us | Measures frequencies from:<br>10 Hz to 100 Hz<br>100 Hz to 1 KHz<br>1 KHz to 10 KHz<br>10 KHz to 100 KHz<br>100 KHz to 1 MHz | Front Panel 1220 BLACK |
| X10 VERNIER | VAR | Continuous adjustment between each frequency range | Front Panel 1220 RED |
| | CAL | Cal Position is determined by KNOB FULLY CCW | |
| VERT POS. | VAR | Vertical positioning | Behind trap door on Front Panel |
| HORZ POS. | VAR | Horizontal positioning | Behind trap door on Front Panel |
| FOCUS | VAR | Focus Control | Behind trap door on Front Panel |
| INT | VAR | Intensity Control | Behind trap door on Front Panel |
| ANGLE | VAR | Trace Angle control adjusts the angle of the trace on the CRT | Below module (Front Center) Adjustable thru a hole on bottom panel of 1201 |
| ASTIG | VAR | Astigmatism Control | (4) |
| TRIGGER SLOPE | + | Selects positive slope of vertical signal for sweep start | (2) |
| | – | Selects negative slope of vertical signal for sweep start | |
| TRIGGER SOURCE | INT | Module triggers from the vertical input signal | (3) |

*Circled numbers refer to Figure 3-4

*Table 3-2. (Continued)*

| CONTROL | POSITION | FUNCTION | LOCATION* |
|---|---|---|---|
| TRIGGER MODE (Option 12005 only) | EXT | Module triggers from an external signal supplied to the TRIG IN BNC on the 1201 rear panel | (5) |
| | AUTO | Trigger signals are generated at approximately 10 Hz rate or synchronized to a higher frequency vertical signal. Provides a trace in the absence of a vertical signal | |
| | TRIG | Disables auto oscillator. Vertical signal must be present to obtain trace | |

*Circled numbers refer to Figure 3-4

## 3-4. CONNECTORS

3-5. Data Check Model 1200 has five group of connectors. These groups are each given a numerical designator for ease in determining their locations. Table 3-3 describes the function and location of each connector and Figures 3-5 and 3-6 show their respective locations and appearance. Figure 3-7 shows the pin location for the Connectors J5001 through J5007.

| CONNECTOR | FUNCTION | LOCATION |
|---|---|---|
| J5001 | Master Board etch connects the necessary voltages from the power supplies to operate channel 1. The inputs from J5028-5029-5030 are coaxially wired to J5001 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |
| J502 | Master Board etch connects the necessary voltages from the power supplies to operate channel 2. The inputs from J5025-5026-5027 are coaxially wired to J5002 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |
| J5003 | Master Board etch connects the necessary voltages from the power supplies to operate channel 3. The inputs from J5022-5023-5024 are coaxially wired to J5003 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |
| J5004 | Master Board etch connects the necessary voltages from the power supplies to operate channel 4. The inputs from J5019-5020-5021 are coaxially wired to J5004 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |
| J5005 | Master Board etch connects the necessary voltages from the power supplies to operate channel 5. The inputs from J5016-5017-5018 are coaxially wired to J5005 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |
| J5006 | Master Board etch connects the necessary voltages from the power supplies to operate channel 6. The inputs from J5013-5014-5015 are coaxially wired to J5006 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |
| J5007 | Master Board etch connects the necessary voltages from the power supplies to operate channel 7. The inputs from J5010-5011-5012 are coaxially wired to J5007 for the signal inputs (Ref. Fig. 3-7 for individual pin numbers). | Master Board |

*Table 3-3. Function and Location of Connectors*

*Table 3-3. (Continued)*

| CONNECTOR | FUNCTION | LOCATION |
|---|---|---|
| J5008 | Mates the high voltage regulator, Assembly 12015007 to the Master Board for distribution to connectors J5001 thru J5007. | Master Board |
| J5009 | Mates the low voltage regulator, Assembly 12015006 to the Master Board for distribution to connectors J5001 thru J5007 | Master Board |
| J5010 | Channel 7 | Rear Panel |
| J5013 | 6 | 1201 |
| J5016 | 5 External | |
| J5019 | 4 Trigger | |
| J5022 | 3 Inputs | Ref. Fig. 3-5 |
| J5025 | 2 | |
| J5028 | 1 | |
| J5011 | Channel 7 | Rear Panel |
| J5014 | 6 | 1201 |
| J5017 | 5 Record | |
| J5020 | 4 (A) | |
| J5023 | 3 Inputs | Ref. Fig. 3-5 |
| J5026 | 2 | |
| J5029 | 1 | |
| J5012 | Channel 7 | Rear Panel |
| J5015 | 6 | 1201 |
| J5018 | 5 Reproduce | |
| J5021 | 4 (B) | |
| J5024 | 3 Inputs | Ref. Fig. 3-5 |
| J5027 | 2 | |
| J5030 | 1 | |

*Figure 3-5. Rear Panel Location of Input Connectors*

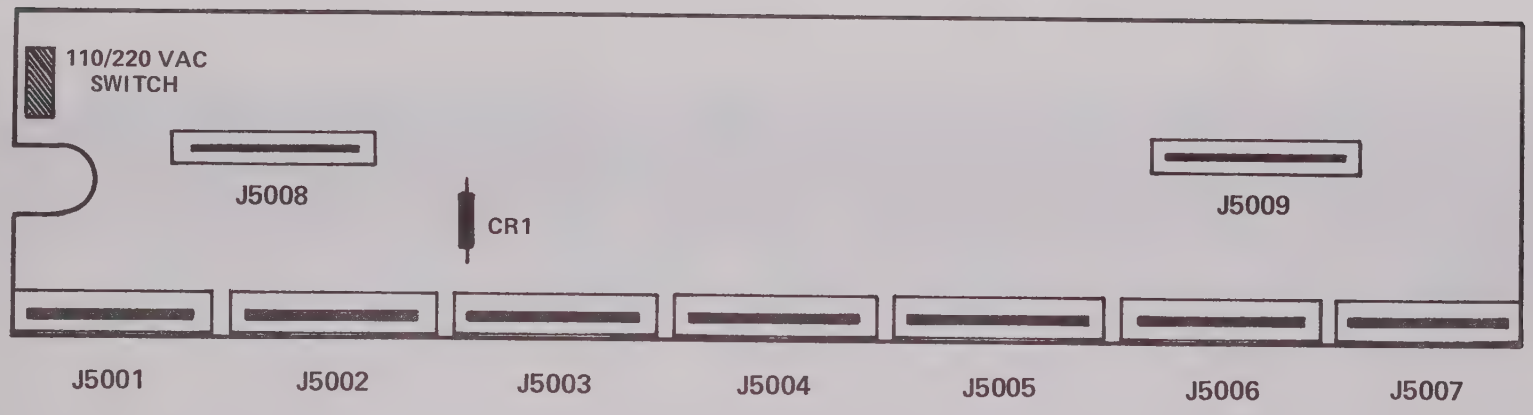
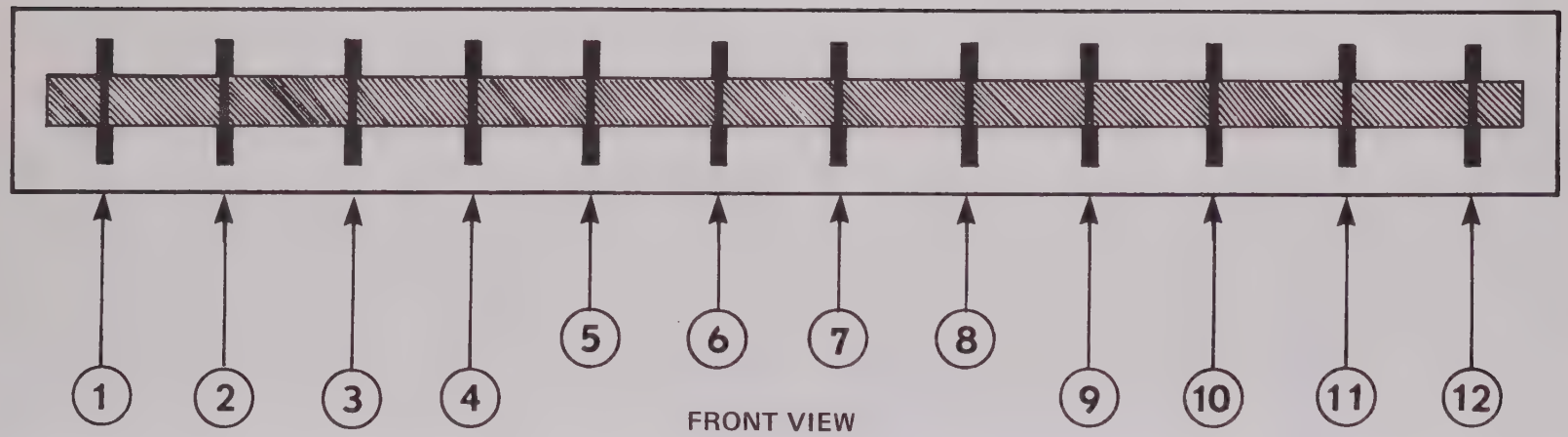



*Figure 3-6. Location of Master Board Connectors*




| | | | |
|---|---|---|---|
| 1 | REP INPUT | 7 | +120 VDC |
| 2 | REC INPUT | 8 | BLANK |
| 3 | 0 VDC (CIRCUIT COMMON) | 9 | 6.3 VAC (–1176 VDC) |
| 4 | TRIGGER INPUT (OPTION 12003 ONLY) | 10 | –1170 VDC |
| 5 | +8 VDC | 11 | –1245 VDC |
| 6 | –8 VDC | 12 | –1200 VDC |

*Figure 3-7. Connector Pin Locations for Connectors J5001 through J5007*

## 3-6. PRE-OPERATION ADJUSTMENTS

3-7. The Series 1200 Monitor Oscilloscope has been preadjusted at the factory and therefore should require no special adjustments prior to operation.

**WARNING**

The voltages used in the Model 1201 Power Supply/Rack Chassis can be lethal. Caution should be used in working on the instrument when the top cover is removed.

3-8. Before applying power to the Model 1200, the unpacking procedure (reference 2-1) must be accomplished to insure the instrument has suffered no damage in shipping or handling.

3-9. Prior to performing any electrical tests, the oscilloscope modules should be positioned as shown in Table 3-4.

| CONTROL | POSITION 1210 | 1220 |
|---|---|---|
| Vertical Position | Centered | Centered |
| Horizontal Position | Centered | Centered |
| Trace Angle | Centered | Centered |
| Focus | Centered | Centered |
| Intensity | Clockwise | Clockwise |
| Tripper Slope | + | + |
| Trigger Source | Int | Int |
| Trigger Mode (12005) | Auto | Auto |
| Vertical Sensitivity | GND | .05 (Knob In) |
| Vertical Vernier | N/A | Calibrate |
| Input Selector | N/A | GND |
| AC/DC | AC (knob in) | AC |
| Sweep Rate | 10 Hz/FS | 20 msec/div |
| X10 Vernier | Calibrate | Calibrate |

*Table 3-4. Pre-Operational Adjustments*

3-10. Preliminary Operation

3-11. With the controls adjusted as shown in Table 3-4, insert the power cord into a 115V AC ±10%, 50 to 400 Hz power source.

**NOTE**

If the instrument is to be operated on 230V AC, Switch S1, located on the master board, must be switched to the 230V AC position.

3-12. Depress the power switch to the extended position. This should turn on the unit.

3-13. Control Verification

3-14. If the unit is functioning properly, a slow moving trace should appear on the face of each CRT. The procedure given in Table 3-5 or 3-6 should be followed to verify the operation of each control. Figure 3-1 shows the location of the front panel controls for each module.

**CAUTION**

Do not leave the intensity control in the maximum clockwise direction with a continuous display for long period of time as phosphor burns on the CRT will result.

3-15. Post-Operational Procedures

3-16. The Series 1200 requires no preventive procedures when the instrument is not in use other than good housekeeping practice of cleanliness. Should the instrument be defective or fail to meet the requirements of Table 3-5 or 3-6, the maintenance section should be consulted for possible correction measure. If information is desired from one of our field representatives or Data Check Corporation, consult the warranty section of this manual.

| STEP NO. | CONTROL | DESCRIPTION |
|---|---|---|
| 1 | Intensity | Adjust the intensity control located beneath the trap door on the front panel for a desired intensity. |
| 2 | Focus | Adjust the focus control located underneath the trap door on the front panel for minimum trace width. The control should have sufficient range to defocus on both sides of the optimum setting. |
| 3 | Vertical Position | Vary the vertical position control located beneath the trap door on the front panel. The control should swing the horizontal trace from the top to the bottom of the CRT face (minimum). Position the trace to the center of the graticule. |
| 4 | Horizontal Position | Vary the horizontal position control located beneath the trap door on the front panel. The control should vary the trace over a minimum range of 2 major divisions. |
| 5 | Trace Angle | Vary the trace angle control located on the underneath side of each module and accessible through a hole on the bottom of the Model 1201 rack chassis through its range. The trace must align with the graticule. |
| 6 | Vertical Sensitivity | Apply signal to the REC input connector located on the rear panel of the Model 1201. The signal should be a 1 KHz sine wave with an amplitude of approximately 1V RMS. Set the Vertical Sensitivity switch on the front panel to the "1V REC" position. A sine wave should appear on the CRT face with an amplitude of approximately full scale. |
| 7 | Vertical Sensitivity | Apply a signal of the same frequency and amplitude to the REP input. Set the Vertical Sensitivity switch to "1V REP". A sine wave should appear on the CRT face with an amplitude of approximately full scale. |
| 8 | Vertical Sensitivity | Set the Vertical Sensitivity switch to "VAR REC" or "VAR REP". The amplitude of the signal can be varied with the two potentiometers located in the center of the front panel as desired. |
| 9 | Sweep Rate | With the input signal on the face of the CRT, rotate the Sweep Rate switch located on the front panel through all five of its positions and note that with each position in a clockwise direction, the sweep rate is increased. Return the switch to the 10 Hz position. |
| 10 | X10 Vernier | With the input signal on the face of the CRT, rotate the horizontal vernier control located on the front panel for variable horizontal sweep rate. The sweep rate should be increased by a factor of at least ten. |

*Table 3-5. 1210 Control Verification Procedure*

| STEP NO. | CONTROL | DESCRIPTION |
|---|---|---|
| 1 | Intensity | Adjust the intensity control located beneath the trap door on the front panel for a desired intensity. |
| 2 | Focus | Adjust the focus control located underneath the trap door on the front panel for minimum trace width. The control should have sufficient range to defocus on both sides of the optimum setting. |
| 3 | Vertical Position | Vary the vertical position control located beneath the trap door on the front panel. The control should swing the horizontal trace from the top to the bottom of the CRT face (minimum). Position the trace to the center of the graticule. |
| 4 | Horizontal Position | Vary the horizontal position control located beneath the trap door on the front panel. The control should vary the trace over a minimum range of 2 major divisions. |
| 5 | Trace Angle | Vary the trace angle control located on the underneath side of each module and accessible through a hole on the bottom of the Model 1201 rack chassis through its range. The trace must align with the graticule. |
| 6 | Input Selector | Apply signal to the REC input connector located on the rear panel of the Model 1201. The signal should be a 1 KHz sine wave with an amplitude of approximately .1V RMS. Set the input selector switch located on the front panel to the "A" position. A sine wave should appear on the CRT face with an amplitude of approximately full scale. |
| 7 | Input Selector | Apply a signal of the same frequency and amplitude to the REP input. Set the input selector to "B". A sine wave should appear on the CRT face with an amplitude of approximately full scale. |
| 8 | Vertical Sensitivity | With the signal on the face of the CRT, rotate the vertical switch located on the front panel through its four positions and note that with each position in a counterclockwise direction, the amplitude of the wave form decreases. Return the switch to its most sensitive position and pull the vertical vernier knob. Again rotate the vertical switch through its four positions and note that with each position in a counterclockwise direction, the amplitude decreases. Depress vertical vernier knob and return switch to its most sensitive position. |
| 9 | Horizontal | With the input signal of the face of the CRT, rotate the horizontal frequency switch located on the front panel through all five of its positions and note that with each position in a clockwise direction, the sweep rate is increased. |

*Table 3-6. 1220 Control Verification Procedure*

*Table 3-6. (Continued)*

| STEP NO. | CONTROL | DESCRIPTION |
|---|---|---|
| 10 | X10 Vernier | With the input signal on the face of the CRT, rotate both the vertical and horizontal vernier controls located on the front panel for both a variable vertical signal and a variable horizontal sweep rate. The sweep rate should be increased by a factor of at least ten. |

# SECTION IV

# THEORY OF OPERATION

## 4-1. GENERAL

4-2. The basic function of an oscilloscope is to provide a visual display to allow the operator to measure and investigate wave forms from various sources. This function is achieved in the Model 1200 Monitor Oscilloscope with the combination of the Model 1201 Power Supply/Rack Chassis and either the 1220 or 1210 Oscilloscope Modules.

4-3. The 1201 Power Supply/Rack Chassis provides (1) a physical housing (2) the DC power and (3) a signal bussing for the oscilloscope modules. Either the 1210 Modules, the 1220 Modules or any combination of both may be used with the 1201. This theory of operation will cover the 1201 Power Supply/Rack Chassis and both modules.

4-4. The basic difference between the 1210 and the 1220 Modules is in the vertical signal switching, vertical attenuation and vertical calibration.

## 4-5. MODEL 1201 POWER SUPPLY/RACK CHASSIS (See block diagram, Figure 4-1)

4-6. The 1201 provides the metal housing for up to seven oscilloscope modules. The unit contains six metal dividers which provide isolation between modules and function as board guides and mechanical supports for each module.

4-7. Each channel has two input signal connectors mounted on the rear panel (14 total) with one external trigger connector (when applicable) for each channel mounted on the rear panel. These connectors are coax coupled to the master board where they are routed to their respective module connectors (J5001 through J5007) for coupling to the oscilloscope module when it is inserted in the chassis.

4-8. The high side of the input power cable (black wire) is carried through the fuse and then connected to the power on-switch. When the switch is in the on position, the power is carried through to the master board. The low side of the input power (white wire) is connected directly to the master board. The input power is connected to a switch which allows selection for 110 VAC or 220 VAC operation.

4-9. The secondary of the power transformer provides the AC voltage to the two power supply regulator boards which are: (1) low voltage regulator board 12015506 (2) high voltage regulator board 12015007. The AC power is connected to the master board where it is distributed to the regulator board connectors J5009 (low voltage) J5008 (high voltage).

## 4-10. LOW VOLTAGE REGULATOR (12015006)

4-11. The low voltage regulator board contains three AC to DC converters which supply the DC output voltages of +8V, −8V, +120V. The AC input to this regulator comes from the secondaries of power transformer T1 through the master board and connector J5009.

## 4-12. +8V REGULATOR

4-13. The +8V DC regulator receives the AC input from secondary S1 of power transformer T1 and converts the AC to DC by a full wave rectifier. The DC voltage is filtered by capacitor C1. The DC voltage is regulated by Integrated Circuit U1, Transistors Q1 and Q2, Resistors R1, R2, R3, R4, R5, R6 and R7 and Capacitor C2. A sample of the regulated output voltage is applied to Regulator U1 at Pin 6 by the resistor voltage divider R5, R6, and R7. Resistor R6 is a variable resistor which pro-

vides a means of adjustment of the output voltage. This sample voltage is compared to an internal reference and an error voltage is generated and applied to the emitter follower Transistor Q2 at the regulator output, Pin 2. The error voltage at the output of Q2 is applied to the power amplifier Transistor Q1. Q1 amplifies the error voltage and applies it to the output for correction of the original error. Resistors R1 and R3 limit the current that the regulator provides. Resistors R2 and R4 are fold back resistors which decrease the maximum current available as the load is increased beyond acceptable limits. Capacitor C2 is the frequency compensation capacitor for Regulator U1. Diode CR1 is a protection diode which limits the reversing of polarity across amplifier Transistor Q1 during turn on transients. Capacitor C3 is the output filter capacitor which reduces the effect of fast changes due to loading.

## 4-14. –8VDC REGULATOR

4-15. The –8V regulator is identical to the +8V regulator with the exception of: (1) the input AC is supplied by secondary F2 from the power transistor and (2) the + output of the regulator is connected to ground and the – output is the –8V output.

4-16. The full wave rectifier is Diode CR4 and the unregulated DC is filtered by Capacitor C4. The Integrated Circuit regulator is U2. The emitter follower transistor is Q4 and the power amplifier transistor is Q3. The resistive voltage divider are Resistors R12, R13 and R14. Resistor R13 is the variable resistor for voltage adjustment. Resistors R8 and R10 are the current limiting resistors and Resistors R11 and R9 control the fold back. Capacitor C5 is the frequency compensation capacitor and Capacitor C6 is the output filter. Diode CR3 is used for protection.

## 4-17. +120VDC REGULATOR

4-18. The +120V regulator is received from Transformer T1, secondary S3 and converts the AC to DC by the full wave bridge rectifier, Diode CR5. This unregulated DC voltage is filtered by Capacitor C7. Resistor R15 provides a discharge path for Capacitor C7 when power on the board is removed.

4-19. A sample of the output voltage is obtained through the resistive voltage divider consisting of Resistors R21, R22 and R23. This voltage is compared to the reference voltage of Zener Diode CR8 by the differential integrated circuit Amplifier U3. Capacitor C10 is the frequency compensation for the voltage divider providing a path for the high frequency variation of the output to the amplifier input. The difference between the sample voltage and the reference is amplified through Integrated Circuit U3 and applied to power pass Transistor Q6. This amplified signal applied to Q6 forces the output to change in a manner which corrects for the original difference between the reference and the sample voltage. For example, if the +120VDC went positive, the voltage sample at Pin 3 of Integrated Circuit U3 would go more positive than Pin 2. This difference would be amplified and the output at Pin 6 would go positive. This positive going voltage is applied to the base Transistor Q6 causing Q6 to turn off and allowing its collector to go negative. When the collector of Q6 goes negative, the unregulated voltage on the + side, Capacitor C7, (+120VDC) will also go more negative which compensates for the original positive error.

4-20. Resistor R30 provides a current path for Diode CR8. Capacitor C9 is used to filter the reference voltage. Diodes CR6 and CR7 limit the differential voltage that can be applied to the input of integrated circuit U3. Capacitor C8 provides frequency compensation for U3. Resistors R16, 17, 18, 19 and Transistor Q5 are for current limiting and fold back. If the voltage across Resistor R19 becomes too large due to excessive current, Transistor Q5 will turn on, which forces Transistor Q6 to turn off. This decreases the output current. Resistors R17 and R18 set the fold back levels. Capa-

citor C11 is the output filter which compensates for fast variations of the load. Integrated Circuit U3 uses the +8 and −8VDC for supply voltage.

4-21. Resistor R24, located on the low voltage regulator board, is used in the high voltage regulator and is not required in the +120VDC regulator.

## 4-22. HIGH VOLTAGE REGULATOR (12015007)

4-23. The high voltage regulator assembly supplies a negative 1200 volt and a negative 1245 volts DC output. The −1245 VDC is achieved by a 45 volt supply which is isolated from ground and has the positive output connected to the −1200 VDC. The AC input to the 1200 VDC and the 45 VDC supply comes from Secondaries S4 and S5 of Transformer T1 via the master board and Connector J5008.

### 4-24. −1200 VDC Regulator

4-25. The AC input for the −1200 VDC comes from Secondary S4. The unregulated DC voltage is generated by a voltage doubler consisting of Diodes CR1, CR2 and Capacitors C1, C2. The +120 VDC is the reference for the −1200 VDC regulator. The −1200 is compared to the +120 VDC by Resistor R24 on the low voltage regulator board and Resistors R12 and R13 on the high voltage regulator board. These resistors are ratioed so that when the proper voltages are applied, the voltage at Pin 3 at Integrated Circuit Amplifier U1 will be 0 volts. When the −1200 VDC is not proper, the voltage at Pin 3 will be other than 0 volts and the voltage will appear as an error voltage to Integrated Circuit U1. This error voltage is amplified and applied to the Power Amplifier Transistors Q1, Q2, Q3, Q4, Q5, and Q6. These transistors are stacked to withstand the voltage that could be applied and operate as an amplifier to correct for the original error. Resistors R1 through R6 divide the total voltage on the transistors evenly. Diodes CR4 and CR5 limit the voltage that can be applied between the inputs of U1. Resistor R11 limits the current that can flow into Pin 2 of U1. Capacitor C9 is the frequency compensation for U1. Capacitor C6 provides the necessary output filtering. Capacitors C7 and C8 are frequency compensation capacitors for the entire regulator.

4-26. Current limiting and fold back is achieved by Resistors R7, R8, R9, R10, R11 and Transistors Q7 and Q8. When the supply draws excessive current, the voltage drop across Resistor R7 will turn on Transistors Q7 which in turn tries to turn off the output amplifier thus limiting the current drain. Resistors R8, R9, R12 and Transistor Q8 provide fold back by decreasing the voltage required across Resistor R7 which turns on Transistor Q7 as the output voltage is decreased. Diode CR6 protects against any major reversal of the voltage at the base of Transistor Q8 during transient.

### 4-27. −1245 VDC Regulator

4-28. The −1245 VDC is a 45 VDC supply which has its positive output connected to the −1200 VDC supply. The AC source for the supply is Secondary S5 of T1. The AC voltage is converted to DC by a full range bridge Rectifier Diode CR3. The AC is filtered by Capacitor C4. The regulated output voltage is established by Zener Diodes CR7 and CR8. This Zenered voltage is connected to emitter follower Transistors Q9 and Q10 which are connected in a darlington configuration. The darlington output, which is the emitter of Transistor Q9 is the power supply output. Resistor R15 is in series with the output and in conjunction with Resistors R16, R17 and Transistor Q11 provide the current limiting and fold back for the supply. Resistors R16 and R17 are the fold back resistors. Resistor R14 is the current path for the Zener. Capacitor C5 is the output filter.

4-29. A jumper is located on the high voltage board which connects the 45 volt supply to the −1200 VDC supply. This jumper may be removed and the 45 volt supply may be connected to ground which will facilitate trouble shooting of the supply or the blanking circuit for any module and will allow operation from the 45 VDC supply.

4-30. MASTER BOARD ASSEMBLY

4-31. The master board provides a means of bussing the signals and voltages between the different sections of the power supply. All of the module Connectors, J5001 through J5007 are located on the master board, as are the power supply Connectors J5008 and J5009. The secondary windings of Transformer T1 are wired to the master board, where they are bussed by etch to their proper connectors. The regulated DC output voltages from both regulated supplies are bussed on the master board to each of the module connectors.

4-32. The cathode ray tube (CRT) filament voltage is supplied by Secondary S6 of Transformer T1 and is wired to the master board and connected by etch to each of the module connectors. In addition, one side of the filament is connected to the −1200 VDC through Zener Diode CR1. The current path for the Zener is on each module board. When a module is inserted in the unit, −1170 VDC is produced.

4-33. The four primary windings of Transformer T1 are wired to the master board along with the input AC power. A switch, S1 connects the primary windings to one of two positions allowing for operation from either a 110 VAC or 220 VAC source.

4-34. The +8VDC is wired from the master board through resistor R1 to Indicator Light DS1 located at the left front of the Power Supply/Rack Chassis.

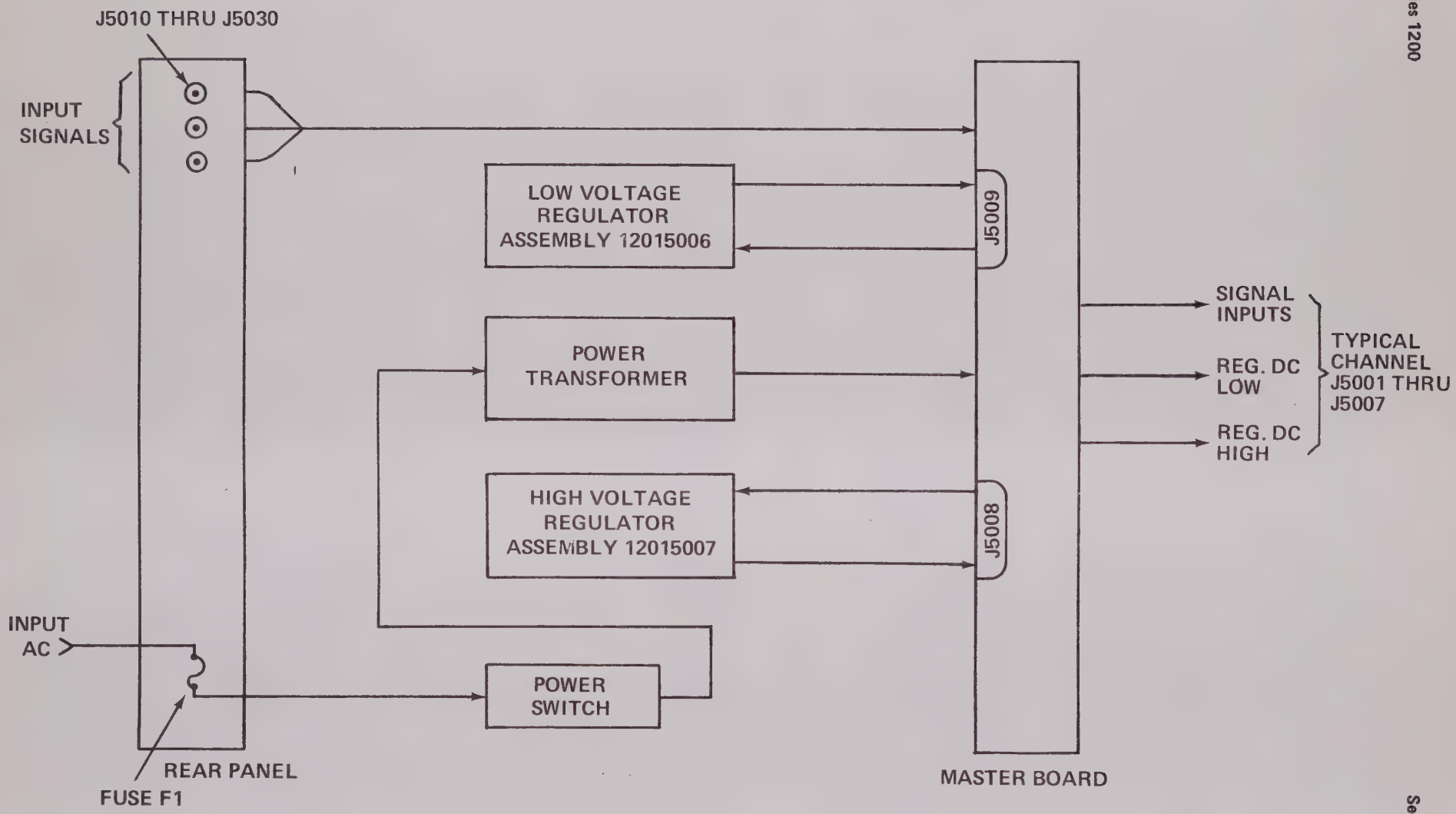



*Figure 4-1. Model 1201 Block Diagram*

## 4-35. OSCILLOSCOPE MODULE ASSEMBLY

### 4-36. General

4-37. The oscilloscope module for the Series 1200 oscilloscope may be either the Model 1220 or the Model 1210. The modules contain all of the circuitry required to display waveforms when DC power supply voltages are provided. Both models are available with the Trigger Mode Option 12005 which allows for either auto or triggered operation. The triggered mode is especially helpful for asymmetrical waveforms. The theory of operation for this option is included following the module theory.

4-38. The primary differences between the Model 1220 and 1210 are found in their input conditioning circuitry. The 1220 uses a standard "Volts/Div" attenuator, whereas the 1210 employes an attenuator which makes this model particularly useful for those applications requiring normalization to a 1V RMS level. In the following theory of operation the two different types of input conditioning will be discussed first. Following that will be the theory of operation for the circuitry which is common to both models.

### 4-39. 1210 Vertical Input Circuitry (Reference Block Diagram, Figure 4-2)

4-40. Both the A (REC) input and the B(REP) input are coupled from the printed circuit connector at the rear of the module to the 1210 vertical sub-assembly by shielded cables. From that point the 1210 vertical input circuitry may be separated into three (3) categories:

1. Vertical Input Switching and Vertical Attenuator (A Section)

2. Vertical Input Buffer

3. Vertical Attenuator (B Section) and Output Buffer

### 4-41. Vertical Input Switching and Vertical Attenuator (A Section)

4-42. The vertical input switching for the 1210 consists of a two position push-pull switch (AC/DC). The AC/DC switch, S1, removes the DC components of the input signals by Capacitors C1 and C2 when S1 is in the AC position. In the DC position the signals are coupled directly through S1 to the (a) level of rotary switch S2. The output of the S2a is coupled through R2 to the input section of the vertical attenuator (A section) consisting of Resistors R3, R4, Capacitors C3, C6 and Variable Capacitor C5. The low frequency portion of the input signal is attenuated by Resistors R3 and R4 whereas the high frequency attenuation is determined by Capacitors C3, C6, and C5. C5 is adjusted to compensate for deviations in distributed capacity to the attenuated point. The input signal is attenuated 3 to 1 by the A section of the attenuator.

4-43. Vertical Input Buffer

4-44. The output of the A section of the attenuator couples directly to the input Field Effect Transistor, U1. Diodes CR1 and CR2 in conjunction with Resistor R3 provide protection if an excessive signal is applied. The diodes conduct to prevent excessive voltage on the input of U1 and R3 limits the current. U1, U2, Q1, and their associated components comprise an input buffer amplifier that separates the A section from the B section of the attenuator. U1, a dual Field Effect Transistor is employed as a dual source follower with one gate used for the input signal and the other gate used for DC balance. The C and D transistors of Integrated Circuit U2 along with Resistors R8, R9, R10, R12, Capacitors C8, C10 and Diode CR3 provide constant current sources for the source loads of U1. The outputs of U1 are coupled to the A and B transistors of U2 which are used in the emitter follower configuration. Q1 in conjunction with CR3, R9, R10, and R6 provides a constant current load for the A transistor of U2, the output of which provides drive to one side of the B section of the vertical attenuator. The B transistor of U2 has R13 for a load and couples to the other side of the B section of the vertical attenuator. The use of U1 as a dual source follower and U2 as a dual emitter follower provides a low impedance drive to the B section of the attenuator. The output of the A transistor of U2 couples to the arm of the b level of S2 (S2b).

4-45. Vertical Attenuator (B Section) and Output Buffer

4-46. The various positions of S2b couple to the variable resistors which provide further attenuation of the vertical signal. Variable Resistors R1, R201, R202, and Resistor R5 comprise the B section of the vertical attenuator. R1 and R5 are located on the vertical subassembly, whereas R201 and R202 are located on a small circuit board near the front of the module so as to be accessible from the module front panel. R1 is adjusted so that 1V RMS on either the REC or the REP input will give full screen deflection. R201 is provided so that the user can normalize the REC channel from the front panel to his desired RMS level. R202 serves the same function for the REP channel. The output points of R201, R202 and R1 couple directly to the (c) level of S2, the arm of which couples the signal to Integrated Circuit U3, a dual differential Darlington emitter follower. The output of the B transistor of U2 couples to the other input of U3 as well as to one side of RC network C4, R5 which, in conjunction with the three (3) potentiometers comprise the B section of the attenuator. U3 serves as an output buffer amplifier and provides very high input impedance for the attenuated input signal and the DC balance signal from U2. R20 and R23 are load resistors for the input set of emitter followers of U3. R21 and R22 are load resistors for the output set of emitter followers of U3. Pins 2 and 10 serve as the output of U3, with Pin 10 being the signal output and Pin 2 being the DC balance output. R25, R26, C12, and C13 are power supply decoupling networks for the vertical attenuator and preamplifier. R14, R16, R17, R19 and Variable Resistor R15 provide the voltage for DC balance of U1, and Capacitor C11 bypasses the DC balance signal. R7 and R11 are parasitic suppressors for U1. C7 and C9 provide high frequency decoupling for the vertical input circuitry.

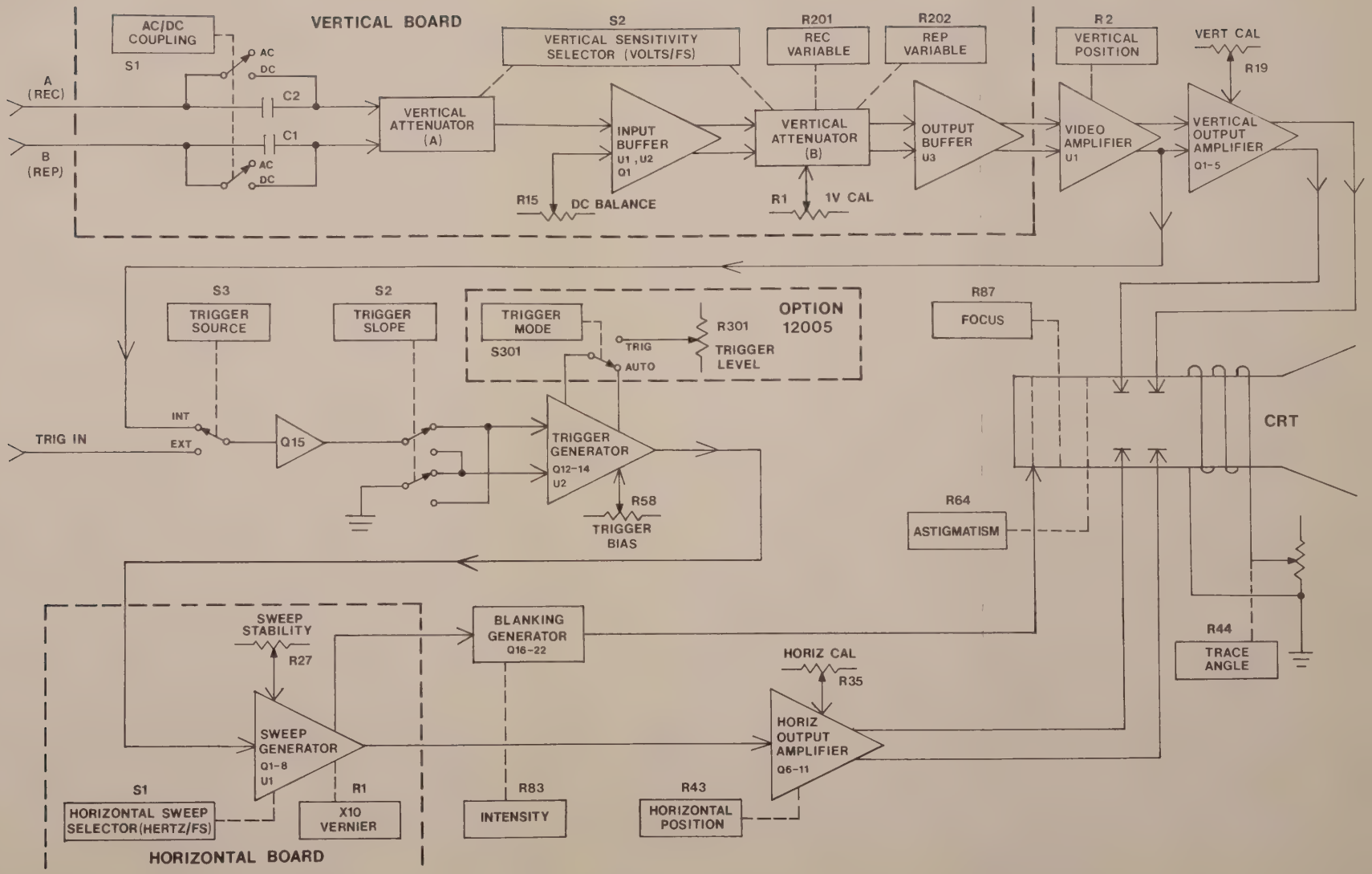



*Figure 4-2. 1210 Block Diagram*

4-47. 1220 Vertical Input Circuitry (Reference Block Diagram, Figure 4-3)

4-48. The 1220 vertical input circuitry may be separated into four (4) categories. They are:

1. Vertical Input Switching
2. Vertical Attenuator (A Section)
3. Vertical Input Buffer
4. Vertical Attenuator (B Section) and Output Buffer

4-49. Vertical Input Switching

4-50. The vertical input switching for the 1220 consists of a three (3) position toggle switch (Input Selector) and a two (2) position slide switch (AC/DC). The Input Selector switch, S201, selects either the A input from the printed circuit connector at the rear of the board, the B input from the printed circuit connector, or ground. The selected input is coupled to the AC/DC switch, S1, where the DC component of the input voltage is removed by Capacitor C1 when S1 is in the AC position. In the DC position the signal is coupled directly through the switch to J1, the connector which couples the signal to the vertical sub-assembly. Both S201 and S1 are located near the front of the module so as to be accessible from the front panel.

4-51. Vertical Attenuator (A Section)

4-52. The input signal is coupled from P1 through R10 to the input section of the vertical attenuator (A section) consisting of Resistors R7, R8, Capacitor C3 and Variable Capacitor C2. The low frequency portion of the signal is attenuated by Resistors R7 and R8 whereas the high frequency attenuation is determined by Capacitors C3 and C2. C2 is adjusted to compensate for deviations in distributed capacity at the attenuated point. The input signal is attenuated 20 to 1 by this attenuator. The two (2) outputs of the A section of the vertical attenuator are coupled to the (a) section of the Vertical Sensitivity push-pull switch, S1. This switch couples the input signal directly to the preamplifier input in the .05 through the .5 positions. In the 1.0 through 10.0 positions S1a couples the attenuated signal to the input buffer.

4-53. Vertical Input Buffer

4-54. The signal from S1a is connected through an RC network consisting of R6 and C1 to the input Field Effect Transistor, U1. Diodes CR1 and CR2 in conjunction with Resistor R6 provide protection if an excessive input signal is applied. The diodes conduct to prevent excessive voltage on the input of U1 and R6 limits the current. U1, U2, Q1 and their associated components comprise an input buffer amplifier that separates the A section and the B section of the attenuator. U1, a dual Field Effect Transistor is employed as a dual source follower with one (1) gate used for the input signal and the other gate used for DC balance. The C and D transistors of Integrated Circuit U2 along with Resistors R13, R14, R15, R17, Capacitor C5 and Diode CR3 provide constant current sources for the source loads of U1. The outputs of U1 couple to the A and B transistors of U2 which are used in the emitter follower configuration. Q1 in conjunction with CR3, R14,R11 and R15 provides a constant current load for the A transistor of U2, the output of which couples to one side of the B section of the vertical attenuator. The B transistor of U2 has R18 for a load and couples to the other side of the B section of the vertical attenuator. The use of U1 as a dual source follower and U2 as a dual emitter follower provides a low impedance drive to the B section of the attenuator.

4-55. Vertical Attenuator (B Section) and Output Buffer

4-56. The B section of the attenuator consists of Potentiometer R1, Resistors R2, R3, R4, R5, and R9. R1 is the variable resistor which provides the X10 vernier gain from the front panel. The remaining resistors provide attenuation in 1-2-5 steps. The various output points of the B section of the attenuator are coupled to two (2) levels of Rotary Switch S2. The outputs of S2 couple to the second section of S1 which couples the attenuated input signal to Integrated Circuit U3, a dual, differential, Darlington emitter follower. U3 serves as an output buffer amplifier and provides very high impedance for the attenuated input signal and the DC balance signal from U2. R25 and R28 are load resistors for the input set of emitter followers of U3. Resistors R29 and R24 are parasitic suppressors for U3. R26 and R27 are load resistors for the output set of emitter followers of U3. Pins 2 and 10 serve as the output of U3, with Pin 10 being the signal output and Pin 2 being the DC balance output. R30, R31, C9, and C10 are power supply decoupling networks for the vertical attenuator and preamplifier. R19, R21, R22, R12 and Variable Resistor R20 provide the voltage for DC balance of U1. Capacitor C8 bypasses the DC balance signal for U1. R12 and R16 are parasitic suppressors for U1 and C4 and C6 provide high frequency decoupling for the vertical input circuitry.

4-57. Vertical Video and Output Amplifiers

4-58. The output signals from the vertical sub-assembly couple through Elco pins to Video Amplifier U1, a differential input/differential output, integrated circuit amplifier. U1 amplifies the signal and applies it to the vertical output amplifier. Pins 1 and 2 of U1 are the inputs and Pins 6 and 7 are the outputs. Resistors R5, R4, Capacitors C2 and C3 are power supply decoupling networks for U1 and Resistors R6, R7, and R3 establish the voltage gain of U1. Resistors R1 and R2 vary the current in the input stage of U1 which provides a DC offset on the signal at the amplifier output. This offset vertically positions the display on the CRT. The output signal from U1 is applied to the vertical output amplifier, a differential amplifier consisting of Transistors Q1, Q2, Q3, Q4 and Q5. Transistor Q5 in conjunction with Resistors R15, R16 and R17 serves as a constant current source for amplifier Transistors Q3 and Q4. Transistors Q1, Q2, Diodes CR1, CR2, CR3, CR4, Resistors R9, R11, R18 and R21 comprise active loads for Q3 and Q4. The active loads provide for improved current slewing capabilities at high frequencies, especially when driving positive. The equivalent resistance of the active loads in conjunction with Resistors R13, R14, R20 and Potentiometer R19 establish the gain of the vertical output amplifier. Potentiometer R19 is used to establish the vertical calibration for the oscilloscope module. Resistor R12 and Capacitor C5 provide for gain increase at higher frequencies to compensate for losses within the vertical circuits. Capacitors C4 and C6 in conjunction with R40 provide power supply decoupling for the vertical output amplifier. The vertical signal from one output of the video amplifier is picked off and coupled through R10 to the trigger generator.

4-59. Trigger Generator

4-60. The purpose of the trigger generator is to provide trigger signals each time the input signal reaches a given level. The trigger signals are used to synchronize the horizontal sweep to the vertical signal. The waveforms applied to the trigger generator may vary greatly in amplitude and shape. The trigger generator "squares up" these various inputs to achieve a standardized square pulse output. The Trigger Source Switch, S3, selects either internal or external triggering.

4-61. When in the Internal position the switch couples the signal from the output of U1 through R10 to the base of Q15, an emitter follower buffer. When in the External position the trigger signal is coupled from the printed circuit connector at the rear of the module through RC network R62 and C18 to the other position of S3. CR7 and CR8 in conjunction with the RC network provide pro-

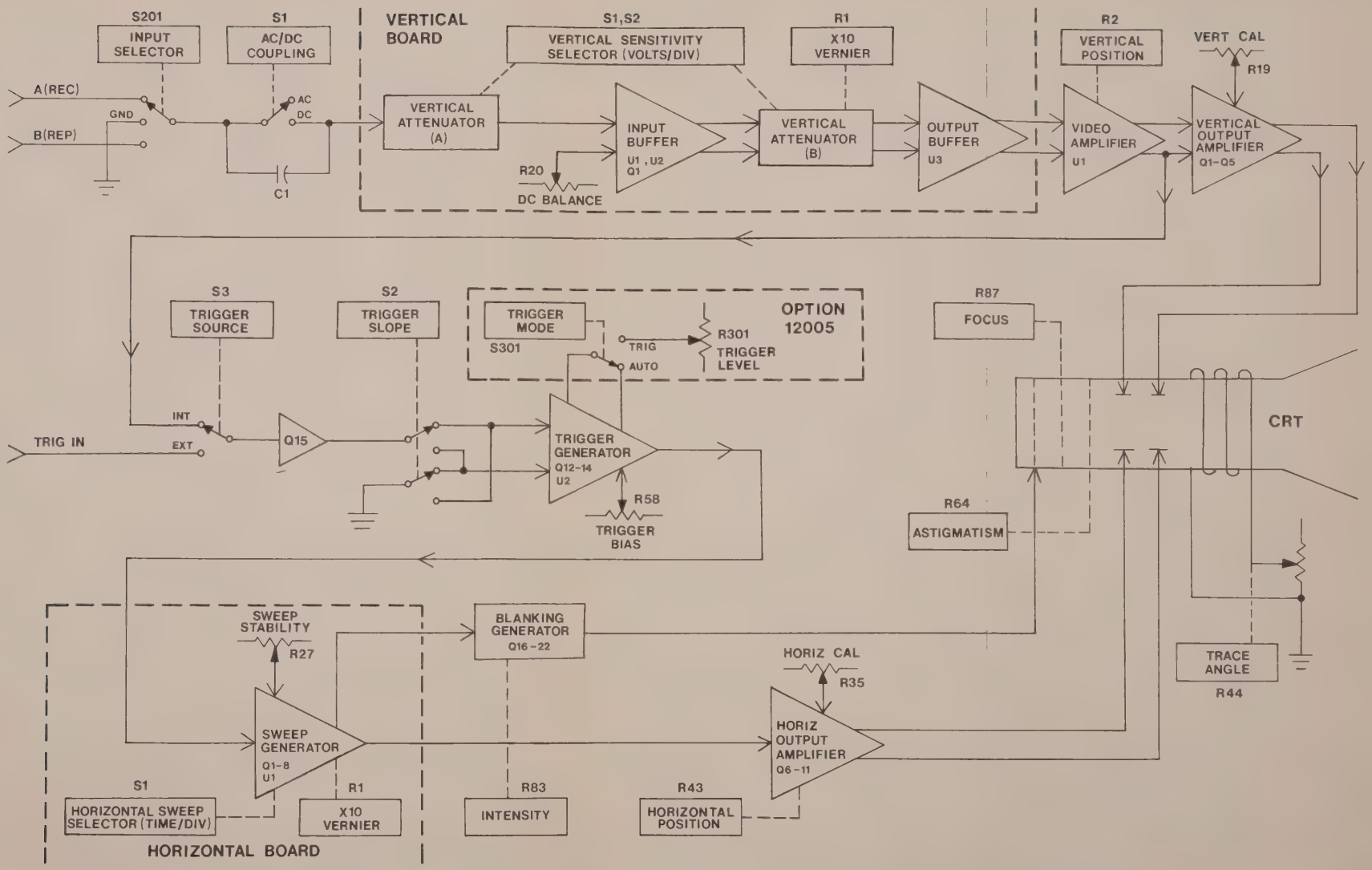



*Figure 4-3. 1220 Block Diagram*

tection in the event of an excessive signal on the external trigger input. CR7 and CR8 conduct to prevent excessive voltage on the base of Q15 and R62 limits the current. Q15, an emitter follower has R61 for a load and buffers the trigger signal providing a low impedance drive for the trigger generator circuit. The output of Q15 couples to S2, the Trigger Polarity switch. S2 is a double pole/double throw switch configured in such a way as to provide two (2) inputs for the trigger generator circuit. One input is always ground and the other always has the trigger signal. One input from S2 is coupled through back-to-back tantalum Capacitors C14 and C15, to the base of Q13. The other input couples through Resistor R60 and back-to-back tantalum Capacitors, C16 and C17, to the base of Q14. C13 bridges the bases of Q14 and Q13 provides high frequency transient suppression. Transistors Q13 and Q14 are emitter followers and provide low impedance driving points for Comparator U2. Resistors R54 and R56 are the emitter loads for Q13 and Q14 and resistors R52 and R55 provide parasitic suppression for the emitter followers. Resistor R48 feeds back the output signal of U2 from Pin 7 to the positive input of U2, Pin 2. Thus, R48 in conjunction with R53 sets a hysteresis level for U2. When the output of U2 is in a given state (either high or low) the hysteresis level must be overcome at the input before the output will switch. The output of U2 is also fed back through R49 to the base of Q13, the emitter of which drives Pin 3, the negative input to Comparator U2. Since the C14/C15 combination is driven from either ground or the low impedance output of Q15, R49 can charge the C14/C15 combination and apply a slow ramp to the base of Q13. The delay associated with the slow ramp in conjunction with the built-in hysteresis level of U2 gives a free running oscillator at approximately a 10 Hz rate. Diodes CR5 and CR6 provide overload protection to the input of U2. Resistors R50 and R51 in conjunction with Q12 provide a low impedance reference point for U2. R46, R47, C11 and C12 are power supply decoupling networks for U2. If no input trigger signal is applied, U2 and its associated components will run at the 10 Hz rate. However, if an input trigger signal at a rate greater than 10 Hz is applied through either the C14/C15 combination or the R60/C16/C17 combination it will overcome the hystersis level, causing the output of U2 to switch, and thereby defeat the tendency of the circuit to free run. When the input trigger signal couples through the C14/C15 combination, a positive transition of the input trigger signal causes a negative transition on the output of U2. Conversely, when the input trigger signal couples through the R60/C16/C17 combination a negative transition of the input trigger signal causes a negative transition on the output of U2. R57, R58, and R59 set the DC level at the base of Q14 so as to make the average DC levels on the inputs of U2 equal. R45 from Pin 7 of U2 to the minus supply decreases the rise time for the negative transition of U2.

4-62. Sweep Generator

4-63. The sweep generator circuitry is located on the horizontal sub-assembly. The output of the trigger generator is coupled through an Elco pin and is differentiated by C15 to achieve a narrow spike used for synchronizing the sweep generator. The purpose of the sweep generator is to provide a waveform subject to the following criteria:

1. Varies in voltage linearly with time.

2. Starts only when triggered by a signal from the trigger generator.

3. Resets automatically upon reaching a predetermined amplitude.

4. Will not restart until it has completely reset and a new trigger signal occurs.

The major components of the sweep generator are Transistors Q1, Q2, Q3, Q4, Q5, Q6, Q7, Q8 and Integrated Circuit U1.

4-64. Transistors Q7 and Q8 in conjunction with Resistors R21, R22, R23, R24, R25, and Capacitor C14 comprise a Schmitt trigger circuit. The input level at Transistor Q8 is established by Resistors R16, R18 and variable Resistor R27 to a level slightly more positive than that required to turn off Q8. Thus the negative-going differentiated spike coupled through Capacitor C15 will turn off Q8 and turn on Q7. When this occurs the Field Effect Transistor switch, Q1 is turned off. When Transistor Q1 is turned off it allows the Integrated Circuit U1 to charge one of the selectable sweep Capacitors, C3, C4, or C1/C2 combination through resistors R2, R3, R4, R5 and the front panel Sweep Vernier Potentiometer R1. The voltage at Pin 6 of Integrator U1 increases linearly in a positive direction until the voltage out of the divider network comprised of R7, R8, and C10 is sufficient to slightly forward bias the base of Transistor Q2. Q2 used in the common base configuration amplifies the turn-on signal at its emitter and applies the amplified signal to the base of Q3. Transistors Q3 and Q5 in conjunction with their associated components comprise a basic monostable multi-vibrator circuit. When the base of Q3 is driven positive, Q3 turns on and its collector drives in the negative direction. The negative transition at the collector of Q3 is coupled through CR3 and selectable timing Capacitor C12, C5, or C6 to the base of Q5. This negative-going transition at the base of Q5 causes Q5 to turn off, causing its collector to go positive. The positive transition at the collector of Q5 is coupled back to the base of Q3 through R14 ensuring that Q3 stays on for as long as Q5 stays off. The selectable timing Capacitor C12, C5, or C6 recharges through R17 bringing the base of Q5 more positive as the timing capacitor charges. When the base voltage of Q5 is more positive than its emitter, Q5 will turn on again and the collector of Q5 will go negative, removing the feedback signal through R14 from the base of Q3. This completes the timing cycle of the monostable multi-vibrator and at this time it is ready to be triggered again by Q2. This time is referred to as "Hold-off" time. R9 serves as a base return resistor for Q3 and R12 is the collector load for Q3. Decoupling Diode CR3 is employed so that the collector of Q3 can make its positive transition quickly without having the responsibility for resetting the charge on the timing capacitor. R16 recharges the timing capacitor at the end of hold-off time. The signal at the collector of Q3 is coupled through RC network R13 and C11 to the base of Q4, an inverting transistor with R15 as its collector load. During hold-off time Q2 turns on, and the collector of Q4 couples a positive level through CR4 to the base of Q8. This positive level is sufficient to drive Q8 into conduction, shutting off Q7, and thus turning on Field Effect Transistor Q1. This state will presist until hold-off time is completed. During this time Q1 terminates the sweep by discharging the sweep capacitor and locking the output of the integrator to the level of the input at Pin 3 which is 0V. This resetting of the sweep turns off Q2 but the monostable multi-vibrator's timing cycle is uninterrupted due to the regenerative action provided by R14. At the end of hold-off time Q4 turns on and decouples CR4 from the base of Q8, leaving Q8 in a turned on state ready to receive the next negative-going trigger spike. During hold-off time the base of Q8 is held far enough positive so that trigger spikes are insufficient to turn off Q8 thus allowing the necessary time for the integrator to completely reset before starting the next sweep.

4-65. Switch S1 selects the proper sweep capacitor and hold-off capacitor for each range. It selects the charge rate of the integrator by switching Resistors R2 and R3 in or out of the circuit. allowing one sweep capacitor to provide two (2) ranges of horizontal timing. Resistor R1 varies the voltage applied to Resistors R3 and R4 which provides a 10 to 1 vernier range of sweep rate. Diodes CR1 and CR2 limit the voltage that can be applied to the input of U1 and Resistor R11 limits the current that can be drawn by Pin 3. Capacitor C9 is the frequency compensation for U4. Transistor Q6, an emitter follower couples the sweep gating signal from the output of the Schmitt trigger at a low driving point impedance to the blanking generator. R19 is the emitter load for Q6 and C13 is a collector bypass for Q6. R20 and L1 are parasitic suppressors for Q6 and R10 serves as transient suppression for the gate drive to Q1.

4-66. Horizontal Output Amplifier

4-67. The horizontal output amplifier amplifies the sweep waveform and applies it differentially to the CRT horizontal deflection plates. It also provides a means to vary the gain to compensate for tolerances in CRT sensitivity and provides DC offset for positioning the trace on the CRT screen.

4-68. The primary components of the horizontal output amplifier are Q6, Q7, Q8, Q9, Q10 and Q11. The amplifier is operated differentially with the sweep waveform utilized as one input and the DC level from the Horizontal Position control as the other input. Transistor Q10, Resistors R29, R30, and R31 serve as a constant current source for the differential gain transistors. Resistor R42, Potentiometer R43, Capacitor C10 and emitter follower Transistor Q11 provide a variable DC level for horizontally positioning the trace from a low driving point impedance. R39 is the emitter load for Q11. Q6 and Q9 are emitter followers having R27 and R34, respectively, as their emitter loads. Transistors Q7 and Q8 are the differential amplifier transistors having Resistors R28 and R32, respectively, as their collector loads. Inductors L1 and L2 provide peaking at high frequencies to increase the bandwidth of the amplifier. R89 and R90 are damping resistors for the coils. Resistors R24 and R33 used as feedback resistors and Resistors R22, R23, R37 and R38 used as input resistors configure this stage as a differential operational amplifier. R25 and R36 serve as bias resistors for Q6 and Q9. Resistor R26 and Variable Resistor R35 establish the gain of the horizontal output amplifier by causing a portion of the input signal to appear as common mode. Capacitor C7 is a speed-up capacitor to compensate for losses at high frequencies due to stray capacity. C8 and R40 serve as a decoupling network for the amplifier's high voltage power supply. The low voltage power supplies for the horizontal output amplifier are decoupled by networks R41, C9 and R65, C20.

4-69. Blanking Generator

4-70. The blanking generator develops a signal which is applied to the grid of the CRT to control the electron beam. The blanking signal is of sufficient amplitude to turn the beam off and on. The blanking signal turns the beam on during the time the sweep is linearly ramping and turns the beam off during holdoff time.

4-71. The output of emitter follower Q6 on the horizontal sub-assembly is coupled through an Elco pin to RC network R68 and C23, the input to the blanking generator. The signal is coupled through the RC network to the base of Q16 which amplifies the signal and decreases its rise and fall times. The signal at the collector of Q16 couples through RC network R70 and C24 to the base of Q17 which logically inverts the signal. Resistors R69 and R71 are the collector load resistors for Q16 and Q17, respectively. The out-of-phase signals from the collectors of Q16 and Q17 are differentiated by Capacitors C26 and C27 and applied to the inputs of a four transistor bistable multi-vibrator. C26 and C27 also provide high voltage isolation since the bistable multi-vibrator operates between −1200 and −1245V DC. The bistable multi-vibrator consists of Q18, Q19, Q20, and Q21 and their associated components. Q19 and Q21 are inverter transistors which receive the differentiated signals from C26 and C27 at their bases. Q18 and Q20 provide switchable active loads for the collectors of Q19 and Q21. R75 and R78 are base returns for Q19 and Q21 and are referenced to −1245V DC along with the emitters of Q19 and Q21. RC networks R74, C30, R77, and C32, provide the cross-coupled regenerative networks for Q19 and Q21. RC networks R73, C29, R76, and C31 provide for coupling the collector signals of Q19 and Q21 to the active load transistors Q18 and Q20. R72 and R79 provide current limiting for the bistable multi-vibrator. R80 couples the blanking signal from the output of the multi-vibrator to the blanking grid of the CRT and Q22 in conjunction with Resistor R84 and Variable Resistor R83 provides a variable DC supply for the multi-vibrator. This variable supply controls the intensity of the trace. R81, R82, C33, and C34 serve as a decoupling network for the

multi-vibrator. C28 provides transient suppression for the multi-vibrator and R91 is a bleeder resistor for the high voltage supply. CR9 provides protection for Q22 in the event of a high voltage short circuit. C35 and C36 provide additional power supply filtering and decoupling for the blanking power supply.

4-72. Cathode Ray Tube

4-73. The cathode ray tube (CRT) operates with its cathode at −1170V DC and the deflection plates near 0V with one side of the filament connected to the −1170V. The focus voltage (applied to Pin 5) is determined by Resistors R85, R86, R88, and the Focus control, Variable Resistor R87. The blanking grid (Pin 3) is connected to the blanking generator and the deflection plates are connected to their respective output amplifiers. Variable Resistor R64 determines the astigmatism voltage applied to Pin 8. A trace angle coil is positioned around the CRT which allows for proper alignment of the trace on the CRT with the graticule. The current to the trace angle coil is determined by Variable Resistor R44.

4-74. Trigger Mode Option 12005

4-75. The trigger mode option (12005) provides for both triggered operation as well as auto operation. The purpose of this option is to increase the triggering versatility of the instrument by allowing triggering from a broader class of waveforms. There are two (2) primary types of signals with which the triggered mode will help: 1) Signals with frequencies below the auto oscillator rate. 2) Signals with an asymmetrical duty cycle. The option consists of Slide Switch S301, Variable Resistor R301 and Resistor R302. When the switch is in the auto position it couples output signals from Pin 7 of U2 through feedback Resistor R49 providing auto operation as described in Sections 4-60 through 4-62. When S301 is in the triggered position the auto oscillator is disabled and R301 in conjunction with R302 sets a DC level to couple through R49 to the base of Q13. Since the auto feature is disabled in this mode, lower frequency signals can be accommodated by the trigger generator. This mode of operation also helps for pulse waveforms having duty cycles different from 50%.

# SECTION V

# MAINTENANCE

## 5-1. GENERAL

5-2. The following procedure provides the information necessary for technical personnel to align and calibrate the Model 1200 Portable Oscilloscope. The alignment should be accomplished at regular periodic intervals to insure the proper operation of the instrument.

5-3. The Series 1200 consists of a Model 1201 Rack Chassis and some combination of: (1) Model 1210 and (2) Model 1220 Oscilloscope Modules. The alignment and calibration of these modules are covered in their respective sections. Figures 5-5 and 5-6 give instructions for removing the plug-in boards if necessary. The calibration of the power supply portion should always be done prior to the signal portion.

**WARNING**

When performing the power supply alignment, the instrument may be operating with the top cover removed. Potentially lethal high voltages are accessible and extreme caution should be taken. Only screwdrivers with insulated shafts should be used for setting the adjustments. The top cover should be removed only for the duration of time required to make the alignments. The power should be off while the cover is being removed or installed.

### 5-4. Test Equipment Required

5-5. The following test equipment is required to align and calibrate the instrument. The model number and manufacturer may be substituted if the specification of the substituted units are equal to, or better than the listed equipment.

| | |
|---|---|
| 1. Function Generator | H-P Model 3310A |
| 2. Frequency Counter | H-P Model 5321B |
| 3. RMS Voltmeter | H-P Model 3400A |
| 4. DC Voltmeter | Fluke Model 8000A |
| 5. Constant Amplitude Generator | Tech Model 191 |

### 5-6. Location of Alignment Adjustments

5-7. Figures 5-1 and 5-3 show the 1210 and 1220, respectively, with plug-in boards removed. Figures 5-2 and 5-4 show the location of alignment adjustments for the 1210 and 1220, respectively. (See Figures 3-2 and 3-3, and 3-4 for the location of operating controls.)

5-8. Power Supply Calibration

5-9. To measure the power supply voltages in the Model 1200, it is necessary to remove the rear cover over the power supplies. ALWAYS REMOVE POWER PRIOR TO REMOVAL OF COVER.

5-10. Low Voltage Regulator (12015006)

5-11. Using the digital voltmeter, measure the three supply voltages of +8, −8 and +120 VDC. The 8 volt supplies should be adjusted to within .1 volts DC. The +120 volts should be adjusted within ±2.5 VDC.

5-12. High Voltage Regulator (12015007)

5-13. Using the multimeter, measure the voltage between the −1200 VDC supply and the −1245 VDC supply. This voltage should be 45 volts ± 10%.

5-14. TEST AND ALIGNMENT PROCEDURE FOR 1210 OSCILLOSCOPE MODULE

5-15. Pre-Alignment

5-16. Preset all screwdriver adjustable, variable resistors to their mid position with the exception of the Intensity control (R83) and Stability adjustment (R27 on horizontal board) which should be set fully clockwise. Set the Sweep Rate switch to the 100 HERTZ/FS position and set the vernier to the Calibrate position. Set the Vertical Sensitivity switch to the GND position.

1. Using a digital voltmeter measure the voltage between Pin 3 and Pin 7 of Integrated Circuit U2 on the vertical board. The voltage should be 0V ±5mV. Adjust the Vertical DC Balance control (R15 on the vertical board) to achieve the proper setting.

2. Adjust the Vertical Position control (R2 on module board) to vertically center the trace on the screen.

3. Adjust the Horizontal Position control (R43 on module board) to horizontally center the trace on the screen.

4. Apply a 2V peak-to-peak, 1 KHz sine wave to the A (REC) input on the rear of the rack chassis and switch the Vertical Sensitivity switch to the 1V REC position.

5. Adjust the Stability control (R27 on the horizontal board) to a point at the middle of its range where the display is stable (at one end, the trace disappears and at the other end, the trace free runs).

6. Adjust the Intensity control (R83 on module board) for the desired brightness.

7. Adjust the Focus control (R87 on module board) for the best trace definition.

8. Adjust the Astigmatism control (R64 on module board) for the best trace definition.

NOTE

It may be necessary to adjust the last three controls to obtain the most desireable waveform. For the remainder of this procedure, the Vertical and Horizontal Positions controls may be adjusted as necessary.

9. Adjust the Trace Angle control (R44 on module board) to align the display with the graticule lines. The Trace Angle control can be adjusted from the bottom of the model 1201 rack chassis. Position the trace symmetrically about the horizontal centerline on the graticule. Adjust the Trigger Bias (R58 on module board) so that the trace starts on the horizontal centerline. Switch the Trigger Slope switch to the opposite polarity and readjust the Trigger Bias to start the trace on the horizontal centerline if necessary.

10. Adjust the Horizontal Calibration (R35 on the module board) for a display of 2 cycles per major division. It may be desirable to adjust the Vertical and Horizontal Position controls to position the peaks of the waveform on the horizontal center-line.

11. Set the output of the sine wave generator to 100 KHz and the Sweep Rate switch to 10 KHz/FS. Adjust the High Frequency Sweep calibration (C1 on horizontal board) for a display of 2 cycles per major division.

12. Remove the 2V peak-to-peak sine wave from the A input at the rear of the rack chassis and apply a 2V peak-to-peak, 1KHz square wave to the A input. Set the Sweep Rate switch to the 1KHz/FS position and adjust the Attenuator Compensation (C5 on vertical board) to achieve the best leading edge on the square wave.

13. Return the Sweep Rate switch to the 10 KHz position and apply a .5V peak-to-peak, 50 KHz sine wave from the constant amplitude generator to the B (REP) input at the rear of the rack chassis. Set the Vertical Sensitivity switch to REP VAR and make sure the Vertical Sensitivity knob is depressed to ensure AC coupling.

14. Set the REP VAR control (R202) fully clockwise and adjust the Vertical Calibration (R19 on module board) for a vertical display equal to the 3 db lines on the graticule. Increase the amplitude of the 50 KHz sine wave to 2V peak-to-peak and switch the Vertical Sensitivity switch to the 1V REP position. Adjust the 1V Calibration (R1 on vertical board) to the 3 db lines on the graticule.

NOTE

It may be necessary to repeat steps 12 through 14 to achieve the desired attenuator compensation and vertical calibration.

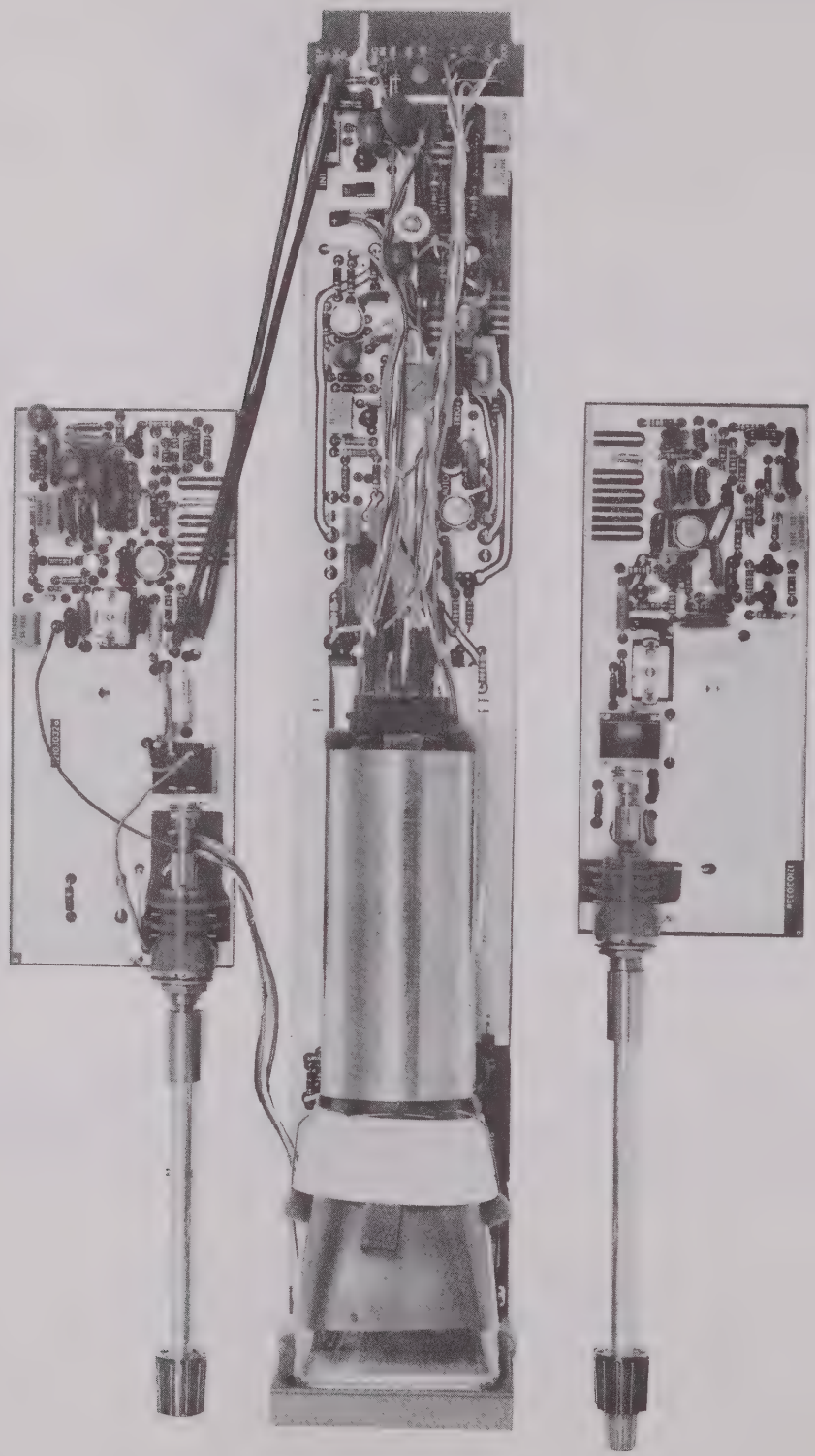


*Figure 5-1. Model 1210 with Plug-in Boards Removed*

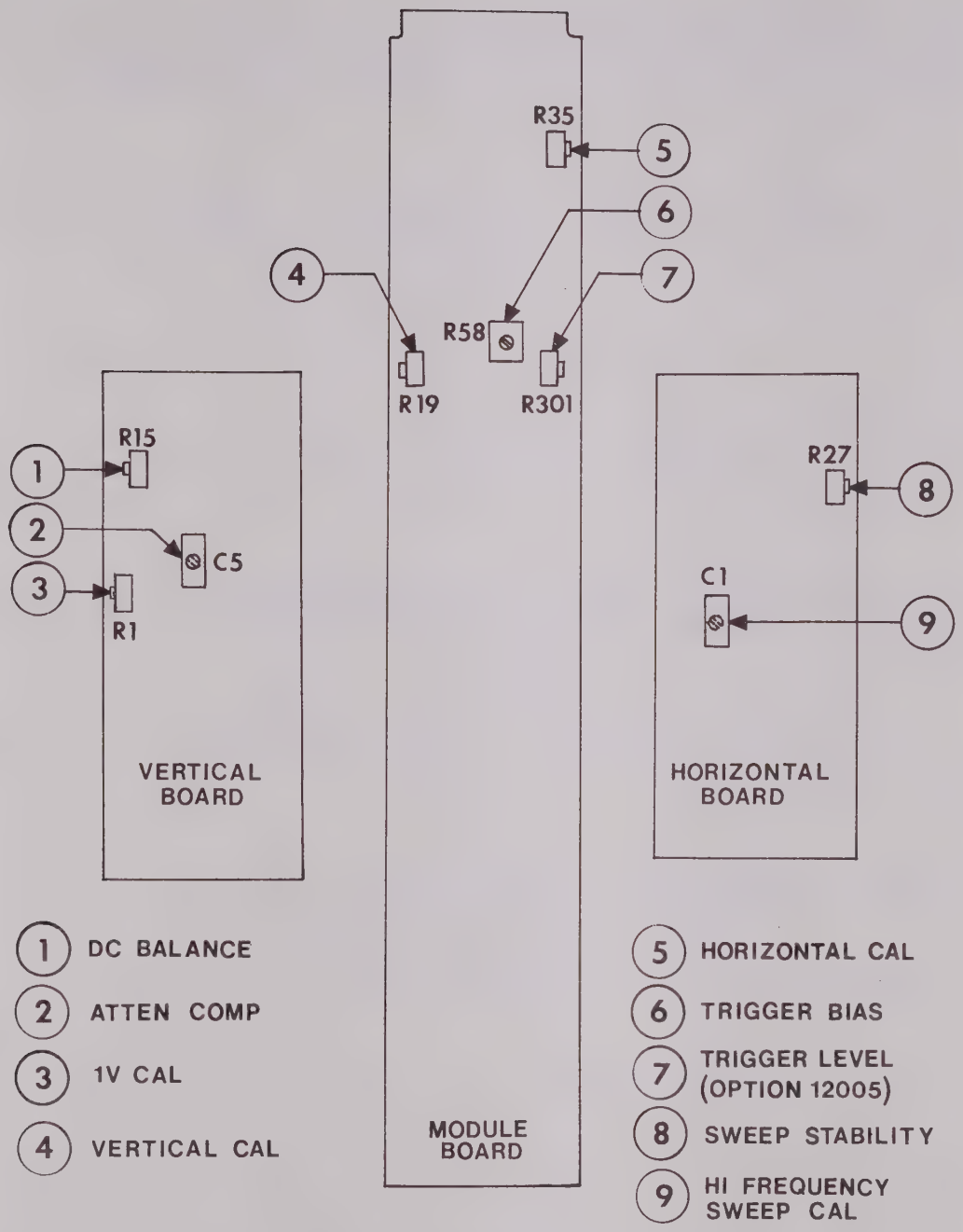



*Figure 5-2. Model 1210 Oscilloscope Module Adjustments*

## 5-17. TEST AND ALIGNMENT PROCEDURE FOR 1220 OSCILLOSCOPE MODULE

5-18. Preset all screwdriver adjustable, variable resistors to their mid position with the exception of the Intensity control (R83) and Stability adjustment (R27 on horizontal board) which should be set fully clockwise. Set the Sweep Rate switch to the 2 msec/div position and set the vernier to the calibrate position. Set the Input Selector switch to the GND position and the Vertical Sensitivity switch to the .5V/div (vertical vernier knob depressed).

1. Using a digital voltmeter measure the voltage between Pin 3 and Pin 7 of Integrated Circuit U2 on the vertical board. The voltage should be 0V ±5mV. Adjust the vertical DC balance control (R20 on the vertical board) to achieve the proper setting.

2. Adjust the Vertical Position control (R2 on module board) to vertically center the trace on the screen.

3. Adjust the Horizontal Position control (R43 on module board) to horizontally center the trace on the screen.

4. Apply a 2V peak-to-peak 1 KHz sine wave to the A (REC) input on the rear of the rack chassis and switch the input selector switch to the A position.

5. Adjust the Stability control (R27 on the horizontal board) to a point at the middle of its range where the display is stable (at one end, the trace disappears and at the other end, the trace free runs).

6. Adjust the Intensity control (R83 on module board) for the desired brightness.

7. Adjust the Focus control (R87 on module board) for the best trace definition.

8. Adjust the Astigmatism control (R64 on module board) for the best trace definition.

**NOTE**

It may be necessary to adjust the last three controls to obtain the desirable waveform. For the remainder of this procedure, the Vertical and Horizontal Position controls may be adjusted as necessary.

9. Adjust the Trace Angle control (R44 on module board) to align the display with the graticule lines. The Trace Angle control can be adjusted from the bottom of the model 1201 rack chassis. Position the trace symmetrically about the horizontal centerline on the graticule. Adjust the Trigger Bias (R58 on module board) so that the trace starts on the horizontal centerline. Switch the Trigger Slope switch to the opposite polarity and readjust the Trigger Bias to start the trace on the horizontal centerline if necessary.

10. Adjust the Horizontal Calibration (R35 on the module board) for a display of 2 cycles per major division. It may be desirable to adjust the Vertical and Horizontal Position controls to position the peaks of the waveform on the horizontal centerline.

11. Set the output of the sine wave generator to 100 KHz and the sweep rate switch to 20 usec/div. Adjust the high frequency sweep calibration (C1 on horizontal board for a display of 2 cycles per major division.

12. Remove the 2V peak-to-peak sine wave from the A input at the rear of the rack chassis and apply a 2V peak-to-peak, 1 KHz square wave to the A input. Set the sweep rate switch to the .2 msec/div and adjust the attenuator compensation (C2 on vertical board) to achieve the best leading edge on the square wave.

13. Return the sweep rate switch to the 20 usec/div and apply a 5V peak-to-peak, 50 KHz sine wave from the constant amplitude generator to the B (REP) input at the rear of the rack chassis. Set the vertical sensitivity switch to 1V/div and make sure the vertical vernier knob is in the out position.

14. Adjust the vertical calibration (R19 on module board) for a vertical display of 5 major divisions on the graticule.

NOTE

It may be necessary to repeat steps 12 through 14 to achieve the desired attenuator compensation and vertical calibration.

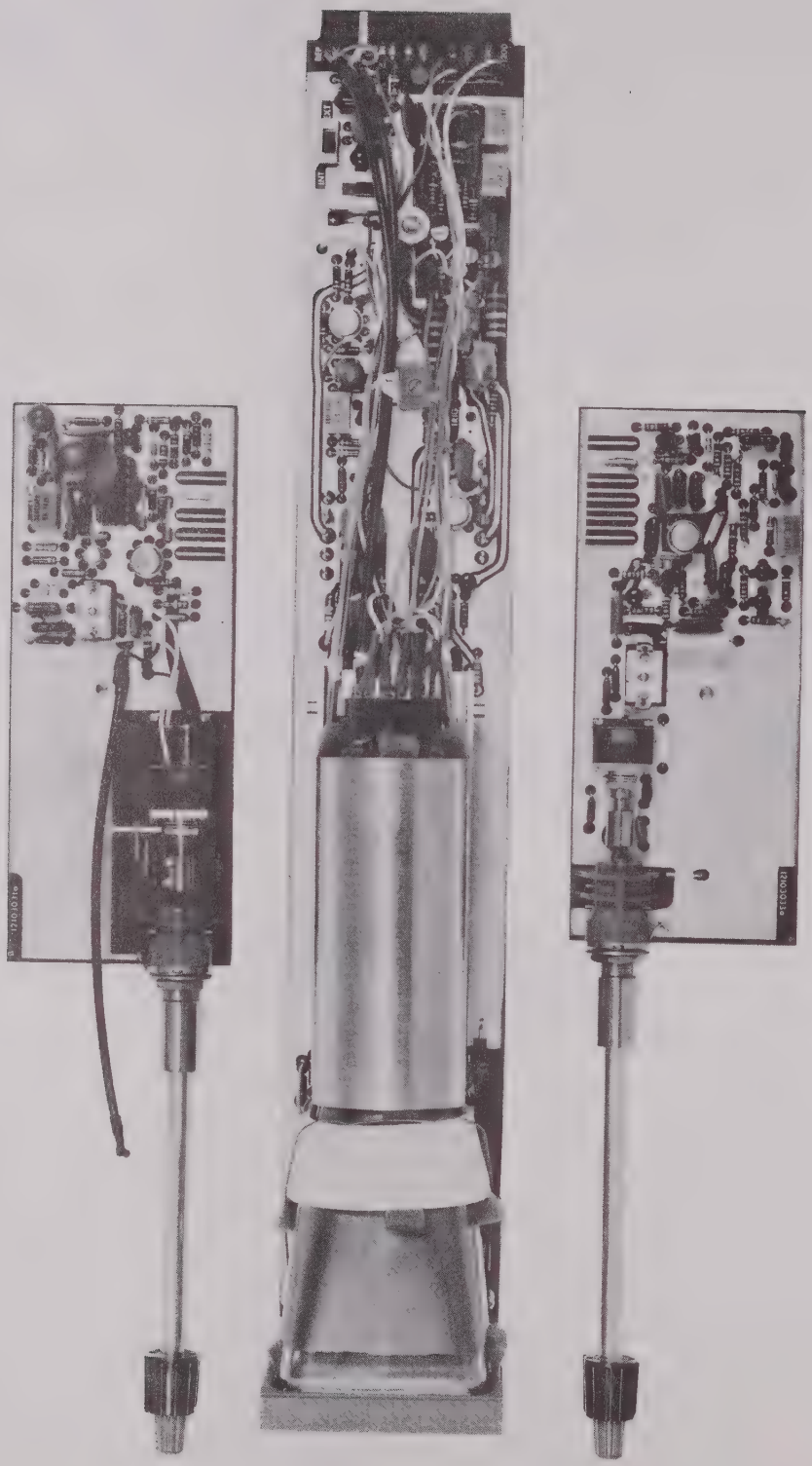


*Figure 5-3. Model 1220 with Plug-in Boards Removed*

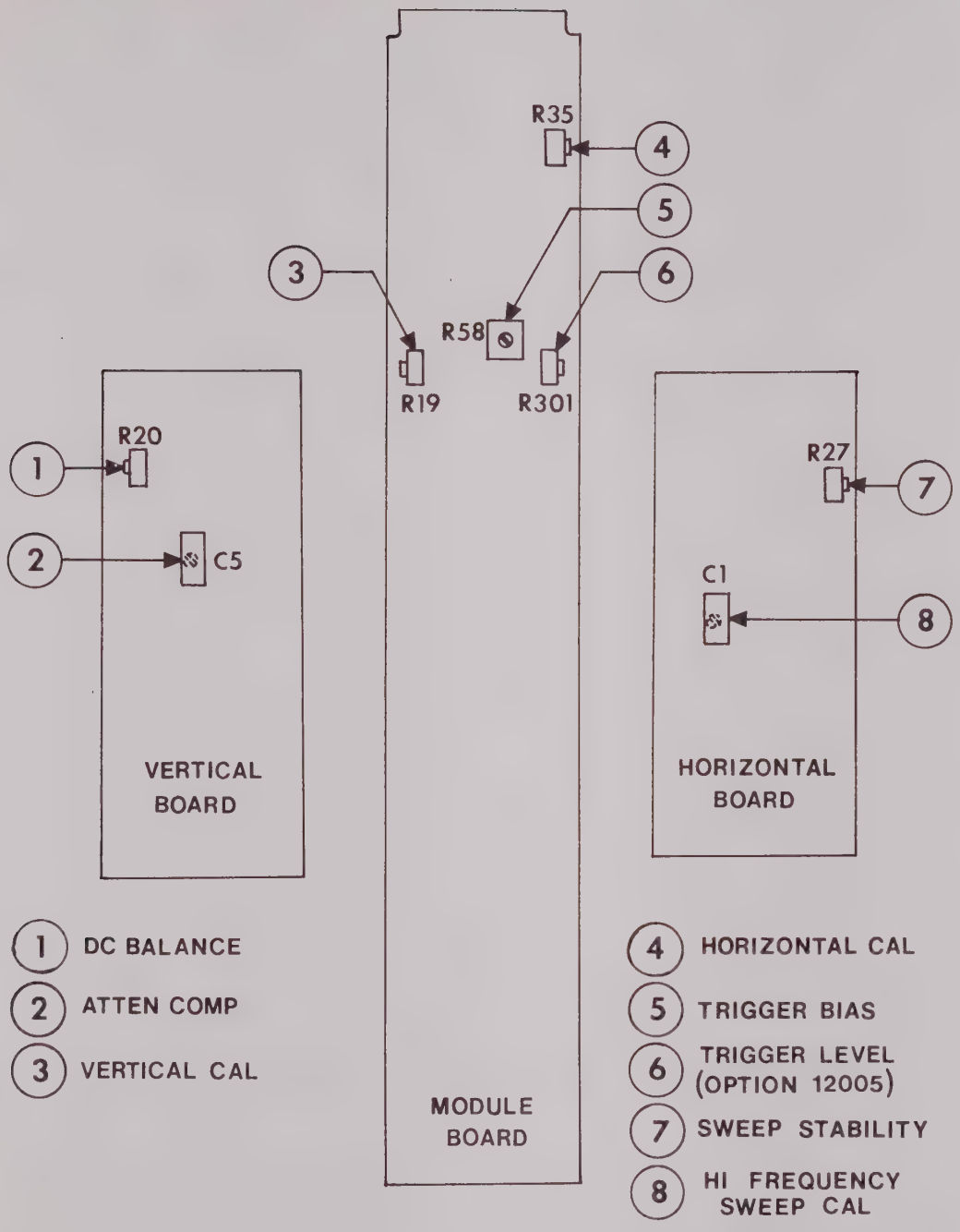



*Figure 5-4. Model 1220 Oscilloscope Module Adjustments*

## 5-19. SPECIFICATION VALIDATION

5-20. Control Preset

A. Set vertical switching to A, AC coupled, 1 volt and the vernier to calibrate.

B. Set the horizontal switch to 2 ms and the vernier to calibrate.

5-21. Vertical Accuracy (1220 Module only)

5-22. Connect the calibration output to the A input. Set the calibrated output to the values shown below, noting that the display on the screen corresponds to the indicated output ±3%.

| CALIBRATION OUTPUT | VERTICAL SWITCH POSITION | DISPLAY |
|---|---|---|
| .2V | .05 | 4 divisions |
| .5V | .1 | 5 divisions |
| 1.0V | .2 | 5 divisions |
| 2.0V | .5 | 4 divisions |
| 5.0V | 1. | 5 divisions |
| 10.0V | 2. | 5 divisions |
| 20.0V | 5. | 4 divisions |
| 50.0V | 10. | 5 divisions |

5-23. Turn the vernier fully counterclockwise and note that the display drops to less than 2 divisions.

5-24. Return the vernier to the calibrate position and switch the AC/DC from AC to DC, noting that the position of the wave form shifts the vertical position by approximately 1/2 peak-to-peak amplitude of the wave form.

5-25. Vertical Accuracy (1210 Module only)

5-26. Set the calibration output to 2 volts and connect to the A input. Note that the display is equal to the 3DB lines on the graticule ±3%. Set the vertical switch to the REC AC variable and turn the REC front panel variable gain fully clockwise. Set the calibration output to 0.5 volts and note that the display is equal to or greater than 4.3 divisions.

5-27. Turn the REC front panel variable gain fully counterclockwise and set the calibration output to 20 volts. Note that the display is equal to or less than 4.25 divisions.

NOTE

Repeat the steps using the REP input and the REP position in the switch.

5-28. Switch the vertical switch from REC AC to REP DC and note that the relative position of the display varies by approximately 1/2 the peak-to-peak amplitude of the wave form.

5-29. Vertical Bandwidth

5-30. Connect the constant amplitude generator to the B REP input and set the vertical switching to B REP AC coupled and 1 volt. Set the output from the generator for 6 vertical divisions at 50 KHz. Increase the frequency of the generator to 2.5 MHz and note the amplitude of the display does not vary by more than 0.6 divisions. Increase the generator frequency to 5 MHz and note that the amplitude of the display does not vary by more than 3DB. (−3DB lines are marked on the graticule.)

5-31. Time Base Accuracy

5-32. Connect the sine wave generator at 2 volts peak-to-peak output to the B input and set the vertical switches to B REP 1 volt and AC coupled.

5-33. Using the counter, set the frequency of the sine wave generator to the frequency shown below for the vertical switch position and note the proper display (it may be advantageous to vertically position the display so the peaks are on the horizontal center line).

| SWITCH | | FREQUENCY | DISPLAY +3% |
|---|---|---|---|
| 1210 | 1220 | | |
| 10 Hz | 20 ms | 100 Hz | 2 cycles per major division |
| 100Hz | 2 ms | 1 KHz | 2 cycles per major division |
| 1 KHz | .2 ms | 10 KHz | 2 cycles per major division |
| 10 KHz | 20 us | 100 KHz | 2 cycles per major division |
| 100KHz | 2 us | 1 MHz | 2 cycles per major division |

5-35. Turn the horizontal vernier fully clockwise and note that the display is equal to or less than 1 cycle across the complete graticule.

5-36. Trigger

5-37. Set the sine wave generator for 1 KHz and the horizontal switch to 2 ms (100 Hz on 1210 Module).

1. Decrease the signal amplitude from the signal generator for a display of 0.5 divisions and note that the unit exhibits a stable display.

2. Increase the frequency of the signal generator to 5 MHz while maintaining the amplitude at 0.5 divisions and note that the unit continues to display a stable signal. (Set the horizontal switch for a desirable display.)

5-38. External Trigger

1. Set the sine wave generator for 1 KHz and .5 division and the horizontal switch at 2 ms (100 Hz on 1210 Module).

2. Switch the +/— slope switch and note that the start of the display switch changes the slope and coincides with the switch position.

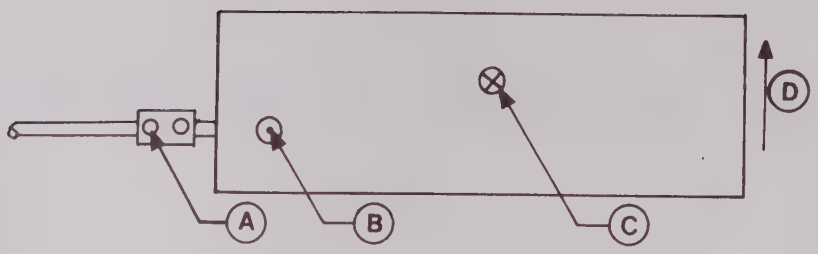
3. Switch the internal/external switch to external and jumper the input signal to the external trigger input at the rear of the rack chassis.

4. Set the generator output to 0.5 volts and note that the unit exhibits a stable display of the signal.

5. Increase the frequency of the generator to 5 MHz and note that the unit exhibits a stable display (set the horizontal switch for a desirable display).

Figures 5-9, 5-10, 5-11, and 5-12 show parts location for the Horizontal board, the 1210 Vertical board, the 1220 Vertical board, and the module board, respectively. Figure 5-7 shows the parts location for the low voltage power supply board and Figure 5-8 shows the parts location for the high voltage power supply board.

## HORIZONTAL ASSEMBLY



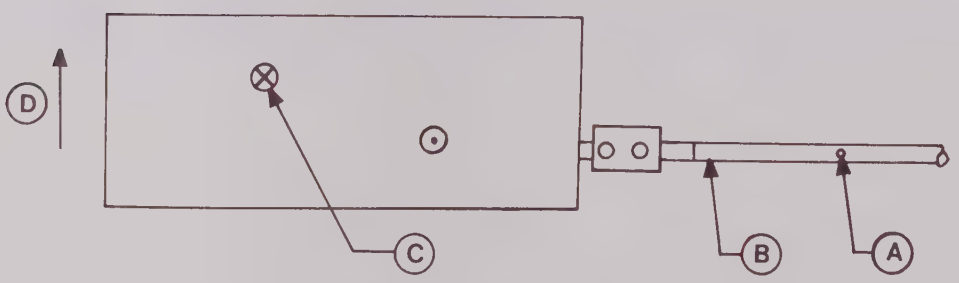

REMOVAL

1—Loosen the front 6-32 set screw (A) on the ¼" shaft coupler.
2—Loosen the front 4-40 set screw (B) on the 1/8" shaft coupler. (This is reached through a hole in the circuit board.)
3—Remove both shaft extensions by pulling on the outer shaft (large) knob, away from the front panel.
4—Remove the 4-40 retainer screw (C) .
5—The horizontal assembly is removed from the Elco pins by pulling away from the master board, shown by arrow (D) .

INSTALLATION

1—Reverse the removal procedures above being careful that the knobs are aligned correctly.

## VERTICAL ASSEMBLY




REMOVAL

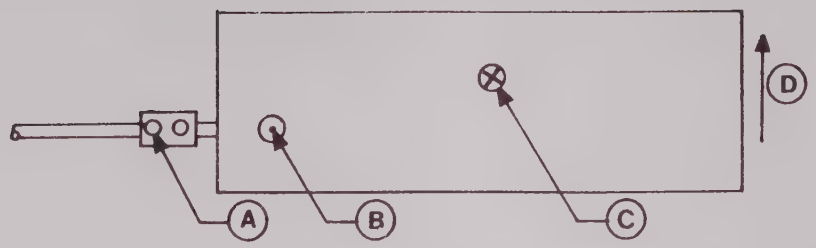
1—Remove the 4-40 set screw (A) from the shaft extension.
2—Remove the outer shaft extension (B) by pulling on the knob, away from the front panel.
3—Remove the 4-40 retainer screw (C) .
4—The vertical assembly is removed from the Elco pins by pulling away from the master board, shown by arrow (D) .

INSTALLATION

1—Reverse the removal procedures above being careful that the knob is aligned correctly.

*Figure 5-5. 1210 Assembly Instructions*

## HORIZONTAL ASSEMBLY



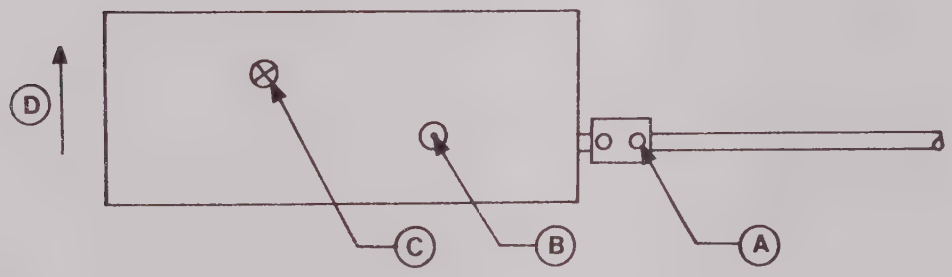

REMOVAL

1—Loosen the front 6-32 set screw Ⓐ on the ¼" shaft coupler.
2—Loosen the front 4-40 set screw Ⓑ on the 1/8" shaft coupler. (This is reached through a hole in the circuit board.)
3—Remove both shaft extensions by pulling on the outer shaft (large) knob, away from the front panel.
4—Remove the 4-40 retainer screw Ⓒ .
5—The horizontal assembly is removed from the Elco pins by pulling away from the master board, shown by arrow Ⓓ .

INSTALLATION

1—Reverse the removal procedures above being careful that the knobs are aligned correctly.

## VERTICAL ASSEMBLY




REMOVAL

1—Loosen the front 6-32 set screw Ⓐ on the ¼" shaft coupler.
2—Loosen the front 4-40 set screw Ⓑ on the 1/8" shaft coupler. (This is reached through a hole in the circuit board.)
3—Remove both shaft extensions by pulling on the outer shaft (large) knob, away from the front panel.
4—Disconnect input coaxial cable by lifting straight up on P-1.
5—Remove the 4-40 retainer screw Ⓒ .
6—The vertical assembly is removed from the Elco pins by pulling away from the master board, shown by arrow Ⓓ .

INSTALLATION

1—Reverse the removal procedures above, being careful that the knobs are aligned correctly.

*Figure 5-6. 1220 Assembly Instructions*

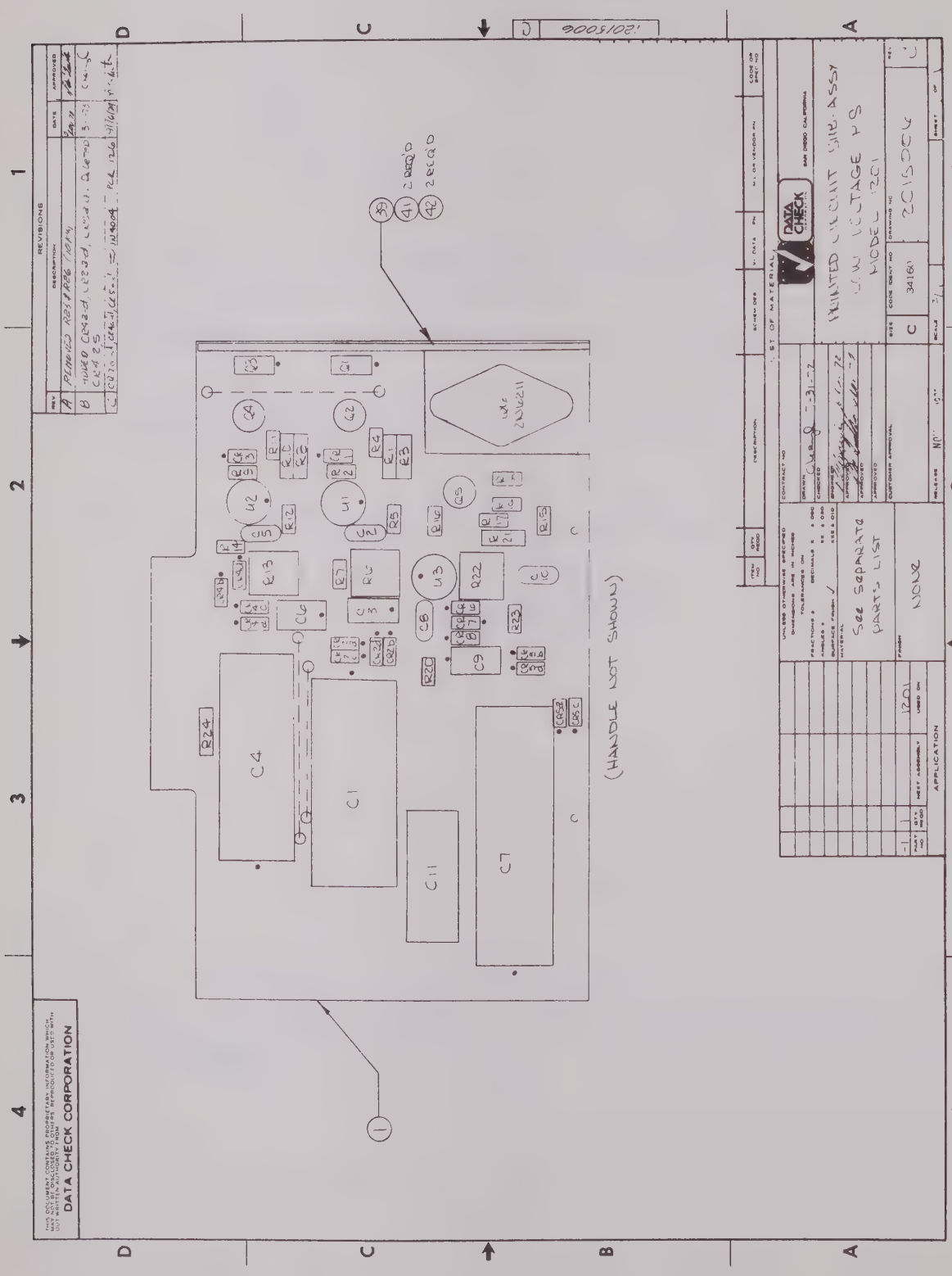



*Figure 5-7. Parts Location For Low Voltage Power Supply Board Sub-Assembly*

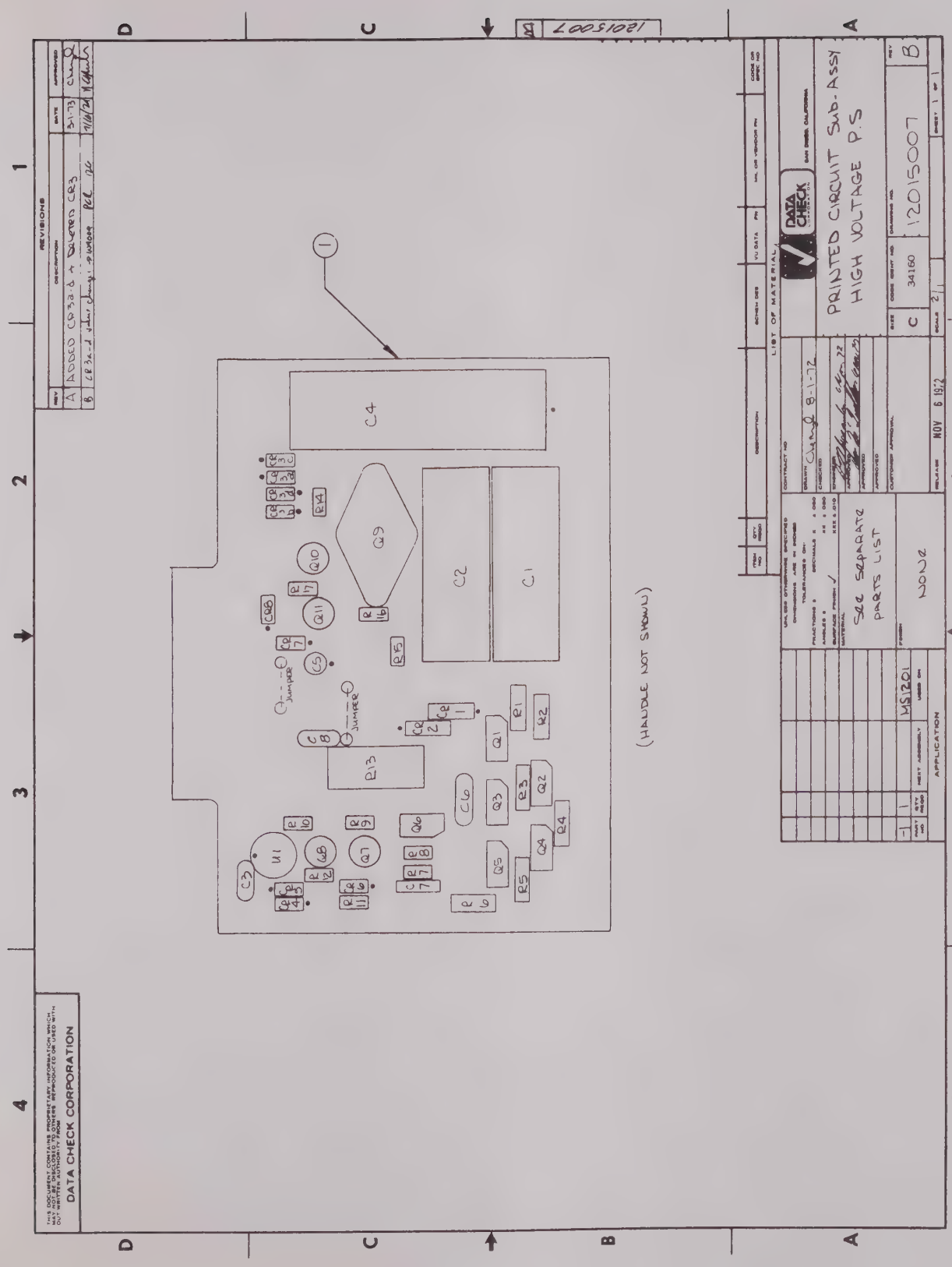



*Figure 5-8. Parts Location For High Voltage Power Supply Board Sub-Assembly*

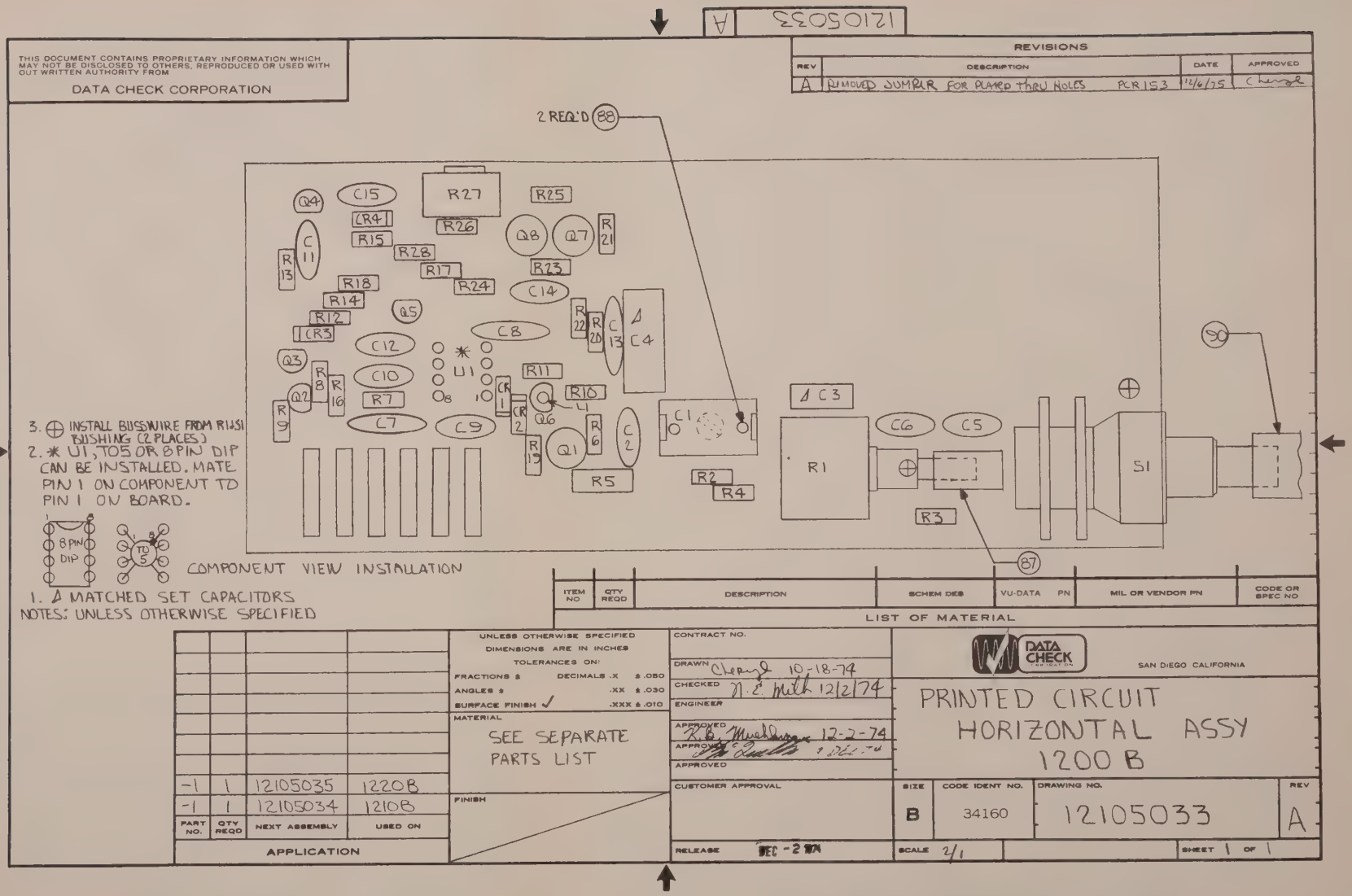

12105033 A
THIS DOCUMENT CONTAINS PROPRIETARY INFORMATION WHICH MAY NOT BE DISCLOSED TO OTHERS, REPRODUCED OR USED WITH OUT WRITTEN AUTHORITY FROM
DATA CHECK CORPORATION
REVISIONS
REV | DESCRIPTION | DATE | APPROVED
A | REMOVED JUMPER FOR PLATED THRU HOLES PCR 153 | 12/6/75 | Cheryl
2 REQ'D (88)
(90)
(87)
R27 R25 R26 Q8 Q7 R21 R23 C14 C15 CR4 R15 R28 R17 R24 R18 R14 R12 CR3 Q4 Q5 Q3 Q2 C11 R13 C12 C10 R7 C7 C9 C8 U1 R11 R10 Q6 Q1 R5 R2 R4 C1 C2 C3 C4 C5 C6 R1 R3 S1
3. ⊕ INSTALL BUSSWIRE FROM R1 TO S1 BUSHING (2 PLACES)
2. * U1, TO5 OR 8 PIN DIP CAN BE INSTALLED. MATE PIN 1 ON COMPONENT TO PIN 1 ON BOARD.
8 PIN DIP
TO 5
COMPONENT VIEW INSTALLATION
1. Δ MATCHED SET CAPACITORS
NOTES: UNLESS OTHERWISE SPECIFIED
ITEM NO | QTY REQD | DESCRIPTION | SCHEM DES | VU-DATA PN | MIL OR VENDOR PN | CODE OR SPEC NO
LIST OF MATERIAL
-1 | 1 | 12105035 | 1220B
-1 | 1 | 12105034 | 1210B
PART NO. | QTY REQD | NEXT ASSEMBLY | USED ON
APPLICATION
UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON:
FRACTIONS ± DECIMALS .X ± .050
ANGLES ± .XX ± .030
SURFACE FINISH ✓ .XXX ± .010
MATERIAL
SEE SEPARATE PARTS LIST
FINISH
CONTRACT NO.
DRAWN Cheryl 10-18-74
CHECKED R. E. Muth 12/2/74
ENGINEER
APPROVED R. E. Muth 12-2-74
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE DEC - 2 '74
DATA CHECK
SAN DIEGO CALIFORNIA
PRINTED CIRCUIT HORIZONTAL ASSY 1200 B
SIZE B | CODE IDENT NO. 34160 | DRAWING NO. 12105033 | REV A
SCALE 2/1
SHEET 1 OF 1

*Figure 5-9. Parts Location For Horizontal Board Assembly*

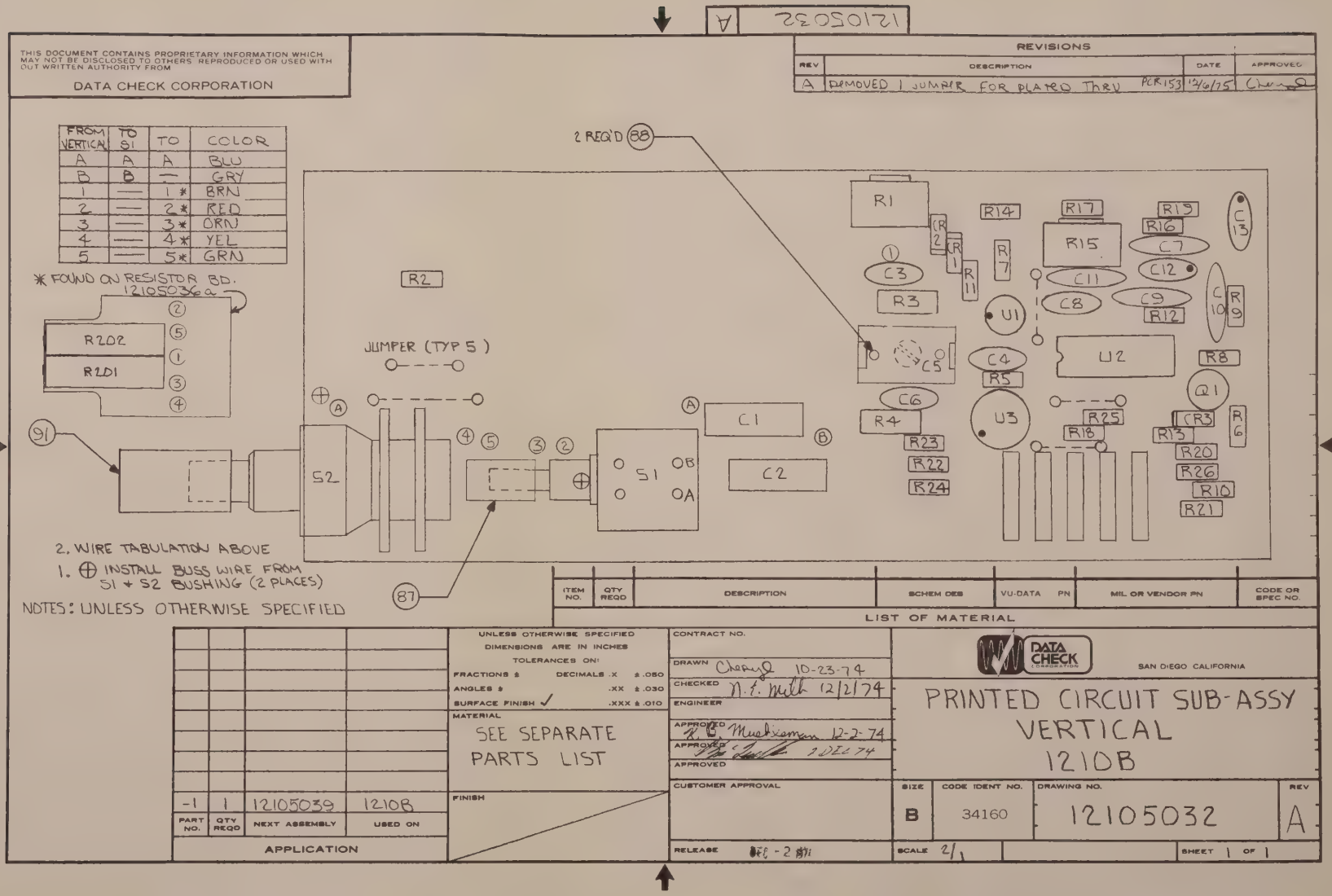



*Figure 5-10. Parts Location For 1210 Vertical Board Sub-Assembly*

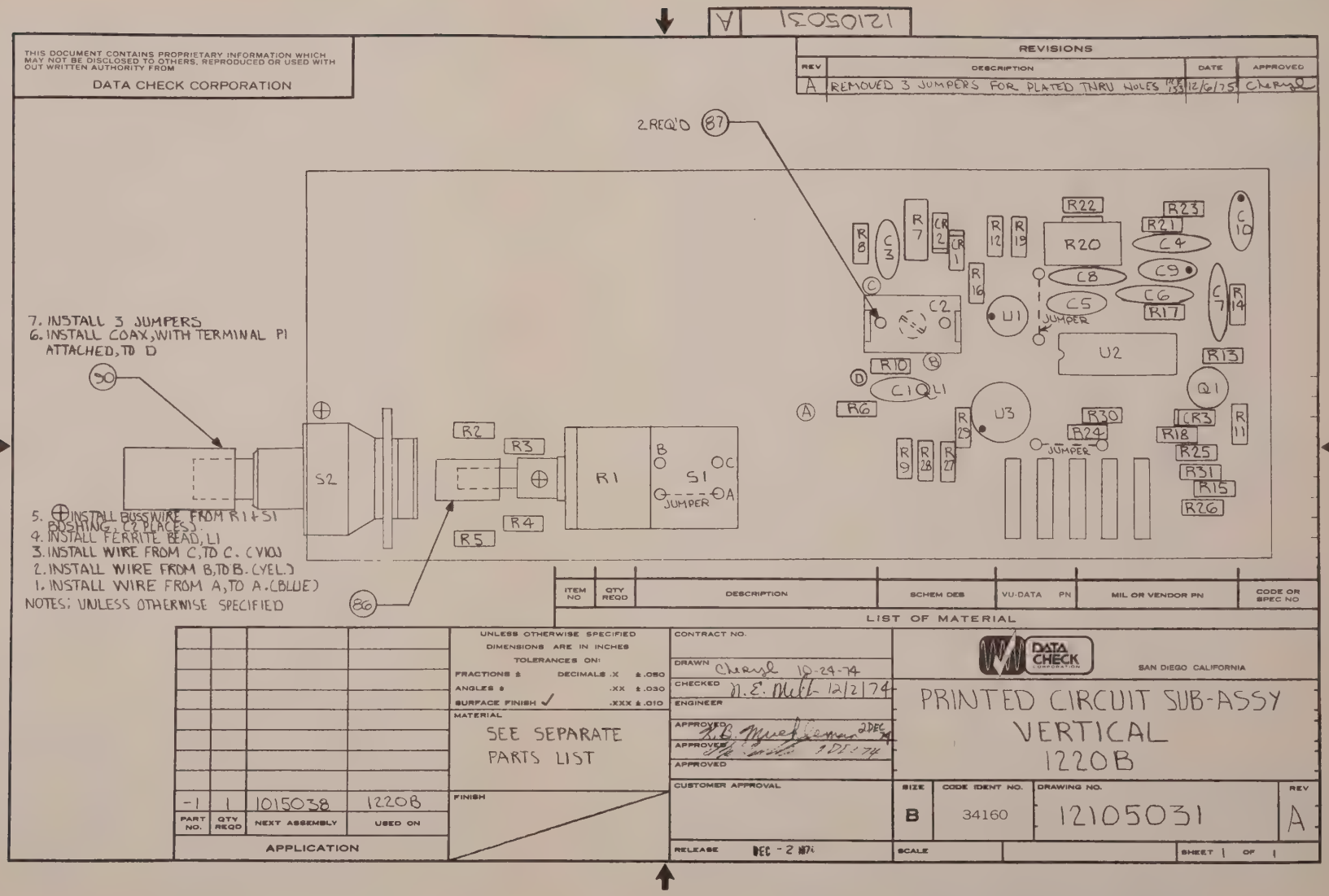



*Figure 5-11. Parts Location For 1220 Vertical Board Sub-Assembly*

DATA CHECK CORPORATION
PRINTED CIRCUIT SUB-ASSY
MODULE OSCILLOSCOPE
1200B
12105030
SEE SEPARATE PARTS LIST
6. -NJ INDICATES NOMINAL VALUE
5.a BOARD TO BOARD WIRE JUMPERING
5.b. CRT WIRE GUIDE
★ ONLY TEFLON WIRE CAN BE USED (7.)
4. ▽ INSTALL POT WITH ADJUSTMENT THRU CIRCUIT BD., AND SECURE POT TO BOARD WITH BUSS WIRE
3. # U2, TO5 OR 8 PIN DIP CAN BE INSTALLED. MATE PIN 1 ON COMPONENT TO PIN 1 ON BD.
COMPONENT VIEW INSTALLATION
2. Δ INSTALL FOR TRIGGER MODE OPTION (12005), & REMOVE JUMPER L
1. * INSTALL S1,C1,&S1 FOR 1220B ASSY ONLY (12105038)
NOTES: UNLESS OTHERWISE SPECIFIED
FOCUS
INTENSITY
HORIZONTAL POSITION
VERTICAL POSITION
TRACE ROTATION

*Figure 5-12. Parts Location For Module Board Sub-Assembly*

# SECTION VI

# PARTS LIST

| Mfg. Code Number | Manufacturer | Location |
|---|---|---|
| 00853 | Sangamo | Marion, Illinois |
| 01121 | Allen Bradley | Milwaukee, Wisconsin |
| 01294 | Texas Instruments | Dallas, Texas |
| 04062 | Elmenco | New York, New York |
| 04713 | Motorola | Phoenix, Arizona |
| 05397 | Kemet | Cleveland, Ohio |
| 07263 | Fairchild | Mt. View, California |
| 12406 | Elpac | Fullerton, California |
| 14099 | Semtech Corp. | Newbury Park, California |
| 14752 | Electrocube | S. Pasadena, California |
| 15818 | Amelco | Mt. View, California |
| 24931 | Specialty Connector, Co., Inc. | Indianapolis, Indiana |
| 26533 | Zero | Burbank, California |
| 27556 | IMB | Santa Fe Springs, California |
| 28520 | Heyman Mfg., Co. (Heyco) | Kenilworth, New Jersey |
| 55792 | Data Check Corp. | San Diego, California |
| 44655 | Ohmite Mfg., Co. | Skokie, Illinois |
| 56289 | Sprague | North Adams, Massachusetts |
| 71450 | CTS | Elkhart, Indiana |
| 71590 | Centralab | Milwaukee, Wisconsin |
| 76055 | Mallory | Frankfort, Indiana |
| 78488 | Stackpole | St. Mary's, Pennsylvania |
| 78553 | Tinnerman Products | Cleveland, Ohio |
| 80368 | Sylvania | New York, New York |
| 81073 | Grayhill | La Grange, Illinois |
| 83330 | H. H. Smith | Brooklyn, New York |
| 84171 | Arco | Great Neck, New York |
| 86684 | RCA | Harrison, New Jersey |
| 87034 | Marco-Oak | Anaheim, California |
| 88245 | Useco | Van Nuys, California |
| 90201 | Mallory | Indianapolis, Indiana |
| 91637 | Dale | Columbus, Nebraska |
| 91662 | Elco | Willow Grove, Pennsylvania |
| 92219 | Waldom | Chicago, Illinois |
| 94222 | Southco | Chester, Pennsylvania |
| 95566 | Arnold Eng. | Orange, California |
| 99800 | Delevan Electric Corp. | Aurora, New York |

*Table 6-1. Manufacturer's Codes*

*Table 6-2 Model 1220 Assemblies*

| TABLE | ASSEMBLY NUMBER | SUB-ASSEMBLY |
|---|---|---|
| 6-5 | 12105035 | Oscilloscope Module Assembly |
| 6-6 | 12105038 | Vertical Assembly |
| 6-7 | 12105031 | Vertical Board Sub-Assembly |
| 6-8 | 12105033 | Horizontal Assembly |
| 6-9 | 12105037 | Module Assembly |
| 6-10 | 12105036 | CRT Sub-Assembly |
| 6-11 | 12105030 | Module Board Sub-Assembly |
| 6-12 | 12105030-3 | Trigger Mode Option 12005 |

*Table 6-3. Model 1210 Assemblies*

| TABLE | ASSEMBLY NUMBER | SUB-ASSEMBLY |
|---|---|---|
| 6-13 | 12105034 | Oscilloscope Module Assembly |
| 6-14 | 12105039 | Vertical Assembly |
| 6-15 | 12105032 | Vertical Board Sub-Assembly |
| 6-8 | 12105033 | Horizontal Assembly |
| 6-9 | 12105037 | Module Assembly |
| 6-10 | 12105036 | CRT Sub-Assembly |
| 6-11 | 12105030 | Module Board Sub-Assembly |
| 6-12 | 12105030-3 | Trigger Mode Option 12005 |

*Table 6-4. Model 1201 Power Supply/Rack Chassis*

| TABLE | ASSEMBLY NUMBER | SUB-ASSEMBLY |
|---|---|---|
| 6-16 | 12015003 | Chassis Assembly |
| 6-17 | 12015005 | Master Board Sub-Assembly |
| 6-18 | 12015006 | PC Sub-Assembly, Low Voltage |
| 6-19 | 12015007 | PC Sub-Assembly, High Voltage |
| 6-20 | 12015008 | Connector Board Sub-Assembly |
| 6-21 | 12015009 | Interconnect Sub-Assembly |
| 6-22 | 12015010 | Rear Panel Sub-Assembly |
| 6-23 | 12015013 | Chassis Frame Sub-Assembly |

*Table 6-5. Parts List — 1220 Oscilloscope Module Assembly (12105035)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12105033 | Horizontal Assy. | 34160 | ——— |
| ——— | 12105037 | Module Assy. | 34160 | ——— |
| ——— | 12105038 | Vertical Assy., 1220 | 34160 | ——— |

*Table 6-6. Parts List – 1220 Vertical Assembly (12105038)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12105031 | Vertical Bd. Sub-Assy. | 34160 | ——— |
| ——— | 12012059 | Front Panel | 34160 | 1-10660 |
| ——— | 12012054 | Bracket – Switch | 34160 | 1-10664 |
| ——— | 12012056 | Concentric Shaft-Vert | 34160 | 1-10665 |
| ——— | 12013005 | Graticule | 34160 | 2-60002 |
| ——— | 12012018 | Filter-Clear | 34160 | 4-20100 |
| ——— | 12012043 | Cover-Controls | 34160 | 1-10223 |
| ——— | 12012071 | Decal-Controls Cover | 34160 | 4-20203 |
| ——— | 12012016 | CRT Spring | 34160 | 1-10332 |
| ——— | 12012065 | Shaft Extension–Vert | 34160 | ——— |
| J1* | 12012076 | Connector, Jack | 34160 | 2-24014 |
| C1* | ZA2C104 | Cap, Met Myl., .1uf ±20%, 200V | 27556 | 6-47104 |
| S1* | E2-104 | Slide Switch-SPDT | GC Elect | 2-10011 |
| S201 | 7211 | Switch, Toggle | C & K | 2-10002 |
| 2 Req. | 1/16x7/16 LDP-302ST | Hinge, Spiral Pin | CEM | 4-20047 |
| 1 Req. | 023-352 | Knob, Blk, ¼" Shaft | Elma | 4-10013 |
| 1 Req. | 021-123 | Knob, Red, 1/8" Shaft | Elma | 4-10009 |
| 1 Req. | 040-103 | Cap, Red, Knob | Elma | 4-10010 |
| 2 Req. | MS51957-11 | Screw,Panhead,4-40x1/8 | ——— | ——— |
| 1 Req. | MS51957-13 | Screw,Panhead,4-40x1/4 | ——— | ——— |
| 1 Req. | MS35333-70 | Washer, Int Lk, No. 4 | ——— | ——— |

*Detailed on Drawing 12105030

*Table 6-7. Parts List — 1220 Vertical Board Sub-Assembly (12105031)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12103031 | Etched Circuit Board | 34160 | 1-20059 |
| | | CAPACITORS | | |
| C1 | 10SS-D15 | CD, .0015uf ±10%, 1KV | 56289 | 6-20152 |
| C2 | C4002/1B | Var, 1.5-20pf | 84171 | 6-96005 |
| C3 | DM15-151J | DM,150pf ±5%, 500V | 04062 | 6-19151 |
| C4 | UK20-104 | CD, .1uf +80% —20%,20V | 71590 | 6-24104 |
| C5 | DM15-360J | DM, 36pf ±5%, 500V | 04062 | 6-19360 |
| C6 | UK20-104 | CD, .1uf +80% —20%,20V | 71590 | 6-24104 |
| C7 | UK20-104 | CD, .1uf +80% —20%,20V | 71590 | 6-24104 |
| C8 | UK20-104 | CD, .1uf +80% —20%,20V | 71590 | 6-24104 |
| C9 | T362C476M 020AS | Tant, 47uf ±20%, 20V | 05397 | 6-74476 |
| C10 | T362C476M 020AS | Tant, 47uf ±20%, 20V | 05397 | 6-74476 |
| L1 | .115 x .125 | Ferrite Bead | Amidon | 5-90001 |
| | | DIODES | | |
| CR1 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR2 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR3 | 1N914 | GP, Signal | 07263 | 3-10914 |
| | | INTEGRATED CIRCUITS | | |
| U1 | FD1673 | FET, Dual N | 22229 | 3-21673 |
| U2 | CA3046 | Array | 18722 | 3-33046 |
| U3 | CA3036 | Array | 18722 | 3-33036 |
| | | RESISTORS | | |
| R1 | 12M137 | Var,Carbon 2.5Kohm | 01121 | 5-79252 |
| R2 | RN55D8250F | MF,825ohm, 1/8W, 1% | 91637 | 5-51185 |
| R3 | RN55D4120F | MF,412ohm, 1/8W, 1% | 91637 | 5-51155 |
| R4 | RN55D82R5F | MF,82.5ohm, 1/8W, 1% | 91637 | 5-51088 |
| R5 | RN55D1650F | MF,165ohm, 1/8W, 1% | 91637 | 5-51117 |
| R6 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R7 | RN60D9533F | MF,953Kohm, 1/8W, 1% | 91637 | 5-50488 |
| R8 | RN55D4992F | MF,49.9Kohm, 1/8W,1% | 91637 | 5-51366 |
| R9 | RN55D1650F | MF,165ohm, 1/8W, 1% | 91637 | 5-51117 |
| R10 | RCR07G181JR | CC,180ohm, ¼W, 5% | 01121 | 5-10181 |
| R11 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |
| R12 | RCR07G121JR | CC,120ohm, ¼W, 5% | 01121 | 5-10121 |
| R13 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |

*Table 6-7. Parts List — 1220 Vertical Board Sub-Assembly (12105031) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R14 | RCR07G622JR | CC,6.2Kohm, ¼W, 5% | 01121 | 5-10622 |
| R15 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R16 | RCR07G121JR | CC,120ohm, ¼W, 5% | 01121 | 5-10121 |
| R17 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |
| R18 | RCR07G392JR | CC,3.9Kohm, ¼W, 5% | 01121 | 5-10392 |
| R19 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R20 | 360T502B | Var,Cer, 5Kohm | 71450 | 5-73502 |
| R21 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R22 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R23 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R24 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R25 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R26 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R27 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R28 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R29 | RCR07G101JR | CC,100ohm, ¼W, 5% | 01121 | 5-10101 |
| R30 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R31 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| | | SWITCHES | | |
| S1 | ------ | Reference R1 | --- | ------ |
| S2 | 12012068 | Rotary, 2 Pol, 4 Pos | 34160 | 2-10040 |
| | | TRANSISTOR | | |
| Q1 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| | | HARDWARE | | |
| Item 86 | 180 | Coupler, Shaft, 1/8" | 83330 | 4-20003 |
| Item 87 | MP170-2 | Terminal,Mini-Pin, .6L | PMP | 2-24015 |
| 5 Req. | 02-005-013-5-200 | Elco Pins | Elco | 2-29994 |
| P1 | MP165-2 | Terminal,Mini-Pin, .3L | PMP | 2-24016 |
| Item 90 | 120 | Coupler, Shaft ¼" | 83330 | 4-20204 |

*Table 6-8. Parts List — Horizontal Assembly (12105033)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ---- | 12103033 | Etched Circuit Bd | 34160 | 1-20057 |
| | | CAPACITORS | | |
| C1 | C4003/1B | Var, 4-45pf | 84171 | 6-96004 |
| C2 | DM15-221J | DM,220pf ±5%, 500V | 04062 | 6-19221 |
| C3 | C1722-2 | .025uf } Matched Set | 27556 | 6-56004 |
| C4 | | .25uf } | | |
| C5 | 5GA-D20 | CD,2000pf ±20%, 1KV | 56289 | 6-20202 |
| C6 | UK25-223 | CD,.022uf ±20%, 25V | 71590 | 6-24203 |
| C7 | UK20-104 | CD,.1uf +80% −20%,20V | 71590 | 6-24104 |
| C8 | UK20-104 | CD,.1uf +80% −20%,20V | 71590 | 6-24104 |
| C9 | DM15-151J | DM,150pf ±5%, 500V | 04062 | 6-19151 |
| C10 | DM15-680J | DM,68pf ±5%, 500V | 04062 | 6-19680 |
| C11 | DM15-150J | DM,15pf ±5%, 500V | 04062 | 6-19150 |
| C12 | DM15-121J | DM,120pf ±5%, 500V | 04062 | 6-19121 |
| C13 | UK20-104 | CD,.1uf +80% −20%,20V | 71590 | 6-24104 |
| C14 | DM15-330J | DM,33pf ±5%, 500V | 04062 | 6-19330 |
| C15 | DM15-050D | DM, 5pf ±.5 pf, 500V | 04062 | 6-19050 |
| L1 | .115 x .125 | Ferrite Bead | Amidon | 5-90001 |
| | | DIODES | | |
| CR1 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR2 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR3 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR4 | 1N914 | GP, Signal | 07263 | 3-10914 |
| | | INTEGRATED CIRCUIT | | |
| U1 | 301A | Amp, 301A | Nat'l | 3-30301 |
| | | RESISTORS | | |
| R1 | 70A1G032R 253U | Var,Carbon, 25K | 01121 | 5-78253 |
| R2 | RN55D6652F | MF,66.5Kohm, 1/8W, 1% | 91637 | 5-51377 |
| R3 | RN55D7321F | MF,7.32Kohm, 1/8W, 1% | 91637 | 5-51286 |
| R4 | RN55D6652F | MF,66.5Kohm, 1/8W, 1% | 91637 | 5-51377 |
| R5 | RN60D6043F | MF,604Kohm, 1/8W, 1% | 91637 | 5-50373 |
| R6 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R7 | RN55D4751F | MF,4.75Kohm, 1/8W, 1% | 91637 | 5-51268 |
| R8 | RN55D8451F | MF,8.45Kohm, 1/8W, 1% | 91637 | 5-51292 |
| R9 | RCR07G103JR | CC,10Kohm, ¼W, 5% | 01121 | 5-10103 |
| R10 | RCR07G472JR | CC,4.7Kohm, ¼W, 5% | 01121 | 5-10472 |
| R11 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R12 | RCR07G682JR | CC,6.8Kohm, ¼W, 5% | 01121 | 5-10682 |

*Table 6-8. Parts List – Horizontal Assembly (12105033) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R13 | RCR07G683JR | CC,68Kohm, ¼W, 5% | 01121 | 5-10683 |
| R14 | RCR07G333JR | CC,33K ohm, ¼W, 5% | 01121 | 5-10333 |
| R15 | RCR07G202JR | CC,2Kohm, ¼W, 5% | 01121 | 5-10202 |
| R16 | RCR07G682JR | CC,6.8Kohm, ¼W, 5% | 01121 | 5-10682 |
| R17 | RCR07G683JR | CC,68Kohm, ¼W, 5% | 01121 | 5-10683 |
| R18 | RCR07G682JR | CC,6.8Kohm, ¼W, 5% | 01121 | 5-10682 |
| R19 | RCR07G472JR | CC,4.7Kohm, ¼W, 5% | 01121 | 5-10472 |
| R20 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R21 | RCR07G681JR | CC,680ohm, ¼W, 5% | 01121 | 5-10681 |
| R22 | RCR07G272JR | CC,2.7Kohm, ¼W, 5% | 01121 | 5-10272 |
| R23 | RCR07G182JR | CC,1.8Kohm, ¼W, 5% | 01121 | 5-10182 |
| R24 | RCR07G681JR | CC,680ohm, ¼W, 5% | 01121 | 5-10681 |
| R25 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |
| R26 | RN55D3921F | MF,3.92Kohm, 1/8W, 1% | 91637 | 5-51250 |
| R27 | 360T501B | Var,Cer, 500ohm | 71450 | 5-73501 |
| R28 | RN55D2431F | MF,2.43Kohm, 1/8W, 1% | 91637 | 5-51230 |
| | | SWITCH | | |
| S1 | 12012067 | Rotary, 4 Pol, 5 Pos | 34160 | 2-10039 |
| | | TRANSISTORS | | |
| Q1 | F2701 | FET 'N' CH | Solitron | 3-22701 |
| Q2 | 2N3906 | PNP, Signal | 04713 | 3-23906 |
| Q3 | 2N3904 | NPN, Signal | 04713 | 3-23904 |
| Q4 | 2N3904 | NPN, Signal | 04713 | 3-23904 |
| Q5 | 2N3904 | NPN, Signal | 04713 | 3-23904 |
| Q6 | 2N3906 | PNP, Signal | 04713 | 3-23906 |
| Q7 | 2N4275 | NPN, Signal | 07263 | 3-24275 |
| Q8 | 2N4275 | NPN, Signal | 07263 | 3-24275 |
| | | HARDWARE | | |
| Item 87 | 180 | Coupler, Shaft, 1/8" | 83330 | 4-20003 |
| Item 88 | MP170-2 | Terminal,Mini-Pin, .6L | PMP | 2-24015 |
| 6 Req. | 02-006-013-5-200 | Elco Pin | Elco | 2-29994 |
| Item 90 | 120 | Coupler, Shaft, ¼" | 83330 | 4-20204 |
| ––– | 12012057 | Concentric Shaft-Horz | 34160 | 1-10663 |
| ––– | 12012066 | Shaft Extension-Horz | 34160 | ––––– |
| 1 Req | 023-352 | Knob, Blk, ¼" Shaft | Elma | 4-10013 |
| 1 Req | 021-123 | Knob, Red, 1/8" Shaft | Elma | 4-10009 |
| 1 Req | 040-103 | Cap, Red Knob | Elma | 4-10010 |
| 1 Req | MS51957-13 | Screw,Panhead,4-40x¼" | ––– | ––––– |
| 1 Req | MS35333-70 | Washer, Int Lk, No. 4 | ––– | ––––– |

*Table 6-9. Parts List — Module Assembly (12105037)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12105030 | Module Bd. Sub-Assy. | 34160 | ————— |
| ——— | 12105036 | CRT Sub-Assy. | 34160 | ————— |
| ——— | 12012055 | CRT Support | 34160 | 1-10658 |
| ——— | 12012058 | Panel Support | 34160 | 1-10659 |
| ——— | 12012069 | CRT Clamp | 34160 | 1-10661 |
| ——— | 12012070 | Front Panel Support | 34160 | 1-10662 |
| ——— | 12012041 | Latch Spacer | 34160 | 1-10218 |
| 1 Req | 207-120241-03-010 | Button, Nylon | Fastex | ————— |
| 3 Req | 8700 | Spacer No. 4 Clear x 1/8" L | 83330 | 4-20163 |
| 1 Req | 8706 | Spacer No. 4 Clear x 5/16" L | 83330 | 4-20105 |
| 1 Req | 2373 | Spacer 4-40THD x ¾" L | 83330 | 4-20166 |
| 1 Req | 2374 | Spacer 4-40THD x 1" L | 83330 | 4-20161 |
| 5 Req | MS51957-13 | Screw,Panhead,4-40x1/4" | ———— | ————— |
| 1 Req | MS51957-15 | Screw,Panhead,4-40x3/8" | ———— | ————— |
| 2 Req | MS51957-17 | Screw,Panhead,4-40x1/2" | ———— | ————— |
| 1 Req | MS24693-2 | Screw,100°Flat,4-40x1/4" | ———— | ————— |
| 1 Req | MS24693-7 | Screw,100°Flat,4-40x5/8" | ———— | ————— |
| 8 Req | MS35333-70 | Washer, Int Lk, No. 4 | ———— | ————— |

*Table 6-10. Parts List — CRT Sub-Assembly (12105036)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| V201 | D7-200GH | Cathode Ray Tube | Brimar | 3-40002 |
| ——— | 12012026 | Tube Shield, CRT | 34160 | 1-10330 |
| L201 | 12012073 | Trace Angle Coil | 34160 | 5-90019 |
| 3 Req | ————— | 4" Strip Foam | 34160 | ————— |
| 4 Req | ————— | 1" Strip Foam | 34160 | ————— |

*Table 6-11. Parts List — Module Board Sub-Assembly (12105030)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12103030 | Etched Circuit Board | 34160 | 1-20058 |
| | | CAPACITORS | | |
| C1 | ————— | ——————————— | ———— | ————— |
| C2 | DDM-103 | CD,.01uf +60% —40%, 150V | 71590 | 6-27103 |
| C3 | DDM-103 | CD,.01uf +60% —40%, 150V | 71590 | 6-27103 |
| C4 | 5HK-S50 | CD,.05uf ±20%, 500V | 56289 | 6-29045 |
| C5 | ————— | TBD | ————— | ————— |
| C6 | 5HK-S50 | CD,.05uf ±20%, 500V | 56289 | 6-29045 |
| C7-N | DM15-020D | DM, 2pf ±.5 pf, 500V | 04062 | 6-19020 |
| C8 | DDM-103 | CD,.01uf +60% —40%, 150V | 71590 | 6-27103 |
| C9 | T362C476M 020AS | Tant,47uf ±20%, 20V | 05397 | 6-74476 |
| C10 | UK20-104 | CD,.1uf +80% —20%,20V | 71590 | 6-24104 |
| C11 | UK20-104 | CD,.1uf +80% —20%,20V | 71590 | 6-24104 |
| C12 | UK20-104 | CD,.1uf +80% —20%,20V | 71590 | 6-24104 |
| C13 | DM15-470J | DM,47pf ±5%, 500V | 04062 | 6-19470 |
| C14 | T362C686M 015AS | Tant,68uf ±20%, 15V | 05397 | 6-73686 |
| C15 | T362C686M 015AS | Tant,68uf ±20%, 15V | 05397 | 6-73686 |
| C16 | T362B225M 035AS | Tant,2.2uf ±20%, 35V | 05397 | 6-75225 |
| C17 | T362B225M 035AS | Tant,2.2uf ±20%, 35V | 05397 | 6-75225 |
| C18 | DM15-102J | DM,1000pf ±5%, 100V | 04062 | 6-19102 |
| C19 | T362C476M 020AS | Tant,47uf ±20%, 20V | 05397 | 6-74476 |
| C20 | T362C476M 020AS | Tant,47uf ±20%, 20V | 05397 | 6-74476 |
| C21 | T362C476M 020AS | Tant,47uf ±20%, 20V | 05397 | 6-74476 |
| C22 | T362C47M 020AS | Tant,47uf ±20%, 20V | 05397 | 6-74476 |
| C23 | DM15-240J | DM,24pf ±5%, 500V | 04062 | 6-19240 |
| C24 | DM15-150J | DM,15pf ±5%, 500V | 04062 | 6-19150 |
| C25 | UK20-104 | CD,.1uf +80% —20%,20V | 71590 | 6-24104 |
| C26 | 30GA-Q22 | CD,22pf ±20%, 3KV | 56289 | 6-20220 |
| C27 | 30GA-Q22 | CD,22pf ±20%, 3KV | 56289 | 6-20220 |

-N Indicates Nominal Value

*Table 6-11. Parts List – Module Board Sub-Assembly (12105030) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| C28 | 30GA-D50 | CD,.005uf ±20%, 3KV | 56289 | 6-20502 |
| C29 | DM15-050D | DM,5pf ±.5pf, 500V | 04062 | 6-19050 |
| C30 | DM15-050D | DM,5pf ±.5pf, 500V | 04062 | 6-19050 |
| C31 | DM15-050D | DM,5pf ±.5pf, 500V | 04062 | 6-19050 |
| C32 | DM15-050D | DM,5pf ±.5pf, 500V | 04062 | 6-19050 |
| C33 | DC-104 | CD,.1uf ±20%, 100V | 71590 | 6-27107 |
| C34 | T362B475M 050AS | Tant,4.7uf ±20%, 50V | 05397 | 6-76475 |
| C35 | DC-104 | CD,.1uf ±20%, 100V | 71590 | 6-27107 |
| C36 | T362B475M 050AS | Tant,4.7uf ±20%, 50V | 05397 | 6-76475 |
| | | CHOKES | | |
| L1 | 70F102A1 | 10mHy | Miller | 5-90005 |
| L2 | 70F102A1 | 10mHy | Miller | 5-90005 |
| L3 | .115 x .125 | Ferrite Bead | Amidon | 5-90001 |
| L4 | .115 x .125 | Ferrite Bead | Amidon | 5-90001 |
| | | DIODES | | |
| CR1 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR2 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR3 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR4 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR5 | 1N194 | GP, Signal | 07263 | 3-10914 |
| CR6 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR7 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR8 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR9 | 1N914 | GP, Signal | 07263 | 3-10914 |
| | | INTEGRATED CIRCUITS | | |
| U1 | U5F7733393 | Amp, 733 | Nat'l | 3-30733 |
| U2 | MC1710CG | Comp, 710 | 04713 | 3-30710 |
| | | RESISTORS | | |
| R1 | RCR07G682JR | CC,6.8Kohm, ¼W, 5% | 01121 | 5-10682 |
| R2 | 360T503B | Var,Cer, 50Kohm | 71450 | 5-73503 |
| R3 | RCR07G182JR | CC,1.8Kohm, ¼W, 5% | 01121 | 5-10182 |
| R4 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R5 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R6 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R7 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R8 | RCR07G222JR | CC,2.2Kohm, ¼W, 5% | 01121 | 5-10222 |

*Table 6-11. Parts List — Module Board Sub-Assembly (12105030) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R9 | RCR42G752JR | CC,7.5Kohm, 2W, 5% | 01121 | 5-40752 |
| R10 | RCR07G101JR | CC,100ohm, ¼W, 5% | 01121 | 5-10101 |
| R11 | RCR07G201JR | CC,200ohm, ¼W, 5% | 01121 | 5-10201 |
| R12 | --------- | TBD | ----- | ------ |
| R13 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R14 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R15 | RN55D2211F | MF,2.21Kohm, 1/8W,1% | 91637 | 5-51226 |
| R16 | RN55D4751F | MF,4.75Kohm, 1/8W,1% | 91637 | 5-51268 |
| R17 | RN55D2050F | MF,205ohm, 1/8W,1% | 91637 | 5-51126 |
| R18 | RCR07G201JR | CC,200ohm, ¼W, 5% | 01121 | 5-10201 |
| R19 | 360T102B | Var,Cer, 1Kohm | 71450 | 5-73102 |
| R20 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R21 | RCR42G752JR | CC,7.5Kohm, 2W, 5% | 01121 | 5-40752 |
| R22 | RN55D5231F | MF,5.23Kohm, 1/8W,1% | 91637 | 5-51272 |
| R23 | RN55D5231F | MF,5.23Kohm, 1/8W,1% | 91637 | 5-51272 |
| R24 | RCR07G564JR | CC,560Kohm, ¼W, 5% | 01121 | 5-10564 |
| R25 | RCR07G223JR | CC,22Kohm, ¼W, 5% | 01121 | 5-10223 |
| R26 | RCR07G272JR | CC,2.7Kohm, ¼W, 5% | 01121 | 5-10272 |
| R27 | RCR07G472JR | CC,4.7Kohm, ¼W, 5% | 01121 | 5-10472 |
| R28 | RCR32G223JR | CC,22Kohm, 1W, 5% | 01121 | 5-30223 |
| R29 | RN55D5231F | MF,5.23Kohm, 1/8W,1% | 91637 | 5-51272 |
| R30 | RN55D5231F | MF,5.23Kohm, 1/8W,1% | 91637 | 5-51272 |
| R31-N | RN55D4990F | MF,499ohm, 1/8W,1% | 91637 | 5-51163 |
| R32 | RCR32G223JR | CC,22Kohm, 1W, 5% | 01121 | 5-30223 |
| R33 | RCR07G564JR | CC,560Kohm, ¼W, 5% | 01121 | 5-10564 |
| R34 | RCR07G472JR | CC,4.7Kohm, ¼W, 5% | 01121 | 5-10472 |
| R35 | 360T253B | Var,Cer, 25Kohm | 71450 | 5-73253 |
| R36 | RCR07G223JR | CC,22Kohm, ¼W, 5% | 01121 | 5-10223 |
| R37 | RN55D5231F | MF,5.23Kohm, 1/8W,1% | 91637 | 5-51272 |
| R38 | RN55D5231F | MF,5.23Kohm, 1/8W,1% | 91637 | 5-51272 |
| R39 | RCR07G273JR | CC,27Kohm, ¼W, 5% | 01121 | 5-10273 |
| R40 | RCR07G820JR | CC,82ohm, ¼W, 5% | 01121 | 5-10820 |
| R41 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R42 | RCR07G103JR | CC,10Kohm, ¼W, 5% | 01121 | 5-10103 |
| R43 | 360T503B | Var,Cer, 50Kohm | 71450 | 5-73503 |
| R44 | 360T103B | Var,Cer, 10Kohm | 71450 | 5-73103 |
| R45 | RCR07G332JR | CC,3.3Kohm, ¼W, 5% | 01121 | 5-10332 |
| R46 | RCR07G220JR | CC,22ohm, ¼W, 5% | 01121 | 5-10220 |
| R47 | RCR07G220JR | CC,22ohm, ¼W, 5% | 01121 | 5-10220 |
| R48 | RCR07G203JR | CC,20Kohm, ¼W, 5% | 01121 | 5-10203 |
| R49 | RCR07G333JR | CC,33Kohm, ¼W, 5% | 01121 | 5-10333 |
| R50 | RCR07G473JR | CC,47Kohm, ¼W, 5% | 01121 | 5-10473 |
| R51 | RCR07G333JR | CC,33Kohm, ¼W, 5% | 01121 | 5-10333 |

-N INDICATES NOMINAL VALUE

*Table 6-11. Parts List – Module Board Sub-Assembly (12105030) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R52 | RCR07G181JR | CC,180ohm, ¼W, 5% | 01121 | 5-10181 |
| R53 | RCR07G181JR | CC,180ohm, ¼W, 5% | 01121 | 5-10181 |
| R54 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R55 | RCR07G181JR | CC,180ohm, ¼W, 5% | 01121 | 5-10181 |
| R56 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R57 | RN55D6812F | MF,68.1Kohm, 1/8W,1% | 91637 | 5-51378 |
| R58 | 360T503B | Var,Cer, 50Kohm | 71450 | 5-73503 |
| R59 | RN55D4222F | MF,42.2Kohm, 1/8W,1% | 91637 | 5-51359 |
| R60 | RCR07G331JR | CC,330ohm, ¼W, 5% | 01121 | 5-10331 |
| R61 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R62 | RCR07G103JR | CC,10Kohm, ¼W, 5% | 01121 | 5-10103 |
| R63 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R64 | 360T104B | Var,Cer, 100Kohm | 71450 | 5-73104 |
| R65 | RCR07G390JR | CC,39ohm, ¼W, 5% | 01121 | 5-10390 |
| R66 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R67 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R68 | RCR07G273JR | CC,27Kohm, ¼W, 5% | 01121 | 5-10273 |
| R69 | RCR07G272JR | CC,2.7Kohm, ¼W, 5% | 01121 | 5-10272 |
| R70 | RCR07G273JR | CC,27Kohm, ¼W, 5% | 01121 | 5-10273 |
| R71 | RCR07G272JR | CC,2.7Kohm, ¼W, 5% | 01121 | 5-10272 |
| R72 | RCR07G221JR | CC,220ohm, ¼W, 5% | 01121 | 5-10221 |
| R73 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R74 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R75 | RCR07G472JR | CC,4.7Kohm, ¼W, 5% | 01121 | 5-10472 |
| R76 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R77 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R78 | RCR07G472JR | CC,4.7Kohm, ¼W, 5% | 01121 | 5-10472 |
| R79 | RCR07G221JR | CC,220ohm, ¼W, 5% | 01121 | 5-10221 |
| R80 | RCR07G332JR | CC,3.3Kohm, ¼W, 5% | 01121 | 5-10332 |
| R81 | RCR07G101JR | CC,100ohm, ¼W, 5% | 01121 | 5-10101 |
| R82 | RCR07G101JR | CC,100ohm, ¼W, 5% | 01121 | 5-10101 |
| R83 | 360T503B | Var,Cer, 50Kohm | 71450 | 5-73503 |
| R84 | RCR07G104JR | CC,10Kohm, ¼W, 5% | 01121 | 5-10104 |
| R85 | RCR20G625JR | CC,6.2Mohm, ½W, 5% | 01121 | 5-20625 |
| R86 | RCR20G625JR | CC,6.2Mohm, ½W, 5% | 01121 | 5-20625 |
| R87 | 360T105B | Var,Cer, 1Mohm | 71450 | 5-73105 |
| R88-N | RCR20G185JR | CC,1.8Mohm, ½W, 5% | 01121 | 5-20185 |
| R89 | RCR07G393JR | CC,39Kohm, ¼W, 5% | 01121 | 5-10393 |
| R90 | RCR07G393JR | CC,39Kohm, ¼W, 5% | 01121 | 5-10393 |
| R91 | RCR07G226JR | CC,22Mohm, ¼W, 5% | 01121 | 5-10226 |
| | | SWITCHES | | |
| S1 | ———— | ———— | ——— | ——— |

-N INDICATES NOMINAL VALUE

*Table 6-11. Parts List – Module Board Sub-Assembly (12105030) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| S2 | C56206L2 | Slide, DPDT | 82389 | 2-10042 |
| S3 | E2-104 | Slide, SPDT | G.C.Elect. | 2-10011 |
| | | TRANSISTORS | | |
| Q1 | 2N5550 | NPN, Signal | 04713 | 3-25550 |
| Q2 | 2N5550 | NPN, Signal | 04713 | 3-25550 |
| Q3 | D40N2 | NPN, Power, HV | GE | 3-240N2 |
| Q4 | D40N2 | NPN, Power, HV | GE | 3-240N2 |
| Q5 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| Q6 | MPSH34 | NPN, Signal | 04713 | 3-20034 |
| Q7 | MPSA43 | NPN, Power, HV | 04713 | 3-20043 |
| Q8 | MPSA43 | NPN, Power, HV | 04713 | 3-20043 |
| Q9 | MPSH34 | NPN, Signal | 04713 | 3-20034 |
| Q10 | MPSH34 | NPN, Signal | 04713 | 3-20034 |
| Q11 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| Q12 | 2N4250 | PNP, Signal | 07263 | 3-24250 |
| Q13 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| Q14 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| Q15 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| Q16 | 2N3906 | PNP, Signal | 04713 | 3-23906 |
| Q17 | 2N3906 | PNP, Signal | 04713 | 3-23906 |
| Q18 | 2N3906 | PNP, Signal | 04713 | 3-23906 |
| Q19 | 2N3904 | NPN, Signal | 04713 | 3-23904 |
| Q20 | 2N3906 | PNP, Signal | 04713 | 3-23906 |
| Q21 | 2N3904 | NPN, Signal | 04713 | 3-23904 |
| Q22 | MPSA43 | NPN, Power, HV | 04713 | 3-20043 |
| XV201* | B13B | Socket, CRT | Cinch | 2-50010 |
| 11 Req | 02-011-113-3-200 | Elco Pins | Elco | 2-29993 |

*Not Detailed on Drawing

*Table 6-12. Parts List — Trigger Mode Option 12005 (12105030-3)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| | | RESISTORS | | |
| R301 | 360T103B | Var, Cer, 10Kohm | 71450 | 5-73103 |
| R302 | RCR07G183JR | CC,18Kohm, ¼W, 5% | 01121 | 5-10183 |
| | | SWITCH | | |
| S301 | E2-104 | Slide, SPDT | G.C.Elec. | 2-10011 |

*Table 6-13. Parts List – 1210 Oscilloscope Module Assembly (12105034)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12105033 | Horizontal Assy. | 34160 | ——— |
| ——— | 12105037 | Module Assy. | 34160 | ——— |
| ——— | 12105039 | Vertical Assy., 1210 | 34160 | ——— |

*Table 6-14. Parts List — 1210 Vertical Assembly (12105039)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12105032 | Vertical Bd. Sub-Assy. | 34160 | ——— |
| ——— | 12012059 | Front Panel | 34160 | 1-10660 |
| ——— | 12012074 | Shaft Extension Set | 34160 | 1-10668 |
| ——— | 12012075 | Shaft Extension-1210 | 34160 | ——— |
| ——— | 12013005 | Graticule | 34160 | 2-60002 |
| ——— | 12012018 | Filter-Clear | 34160 | 4-20100 |
| ——— | 12012072 | Decal-Controls Cover | 34160 | 4-20201 |
| ——— | 12012016 | CRT Spring | 34160 | 1-10332 |
| ——— | 12012043 | Cover-Controls | 34160 | 1-10223 |
| 2 Req | 1/16x7/16 LDP-302ST | Hinge, Spiral Pin | CEM | 4-20047 |
| 1 Req | 023-352 | Knob, Black, ¼" Shaft | Elma | 4-10013 |
| 1 Req | 040-302 | Cap, Black Knob | Elma | 4-10014 |
| 2 Req | MS51957-11 | Screw, Panhead,4-40x1/8" | ——— | ——— |
| 2 Req | MS51957-13 | Screw, Panhead,4-40x1/4 | ——— | ——— |
| 2 Req | MS35333-70 | Washer, Int Lk, No. 4 | ——— | ——— |
| 1 Req | MS15795-804 | Washer, Flat, No. 4 | ——— | ——— |
| 1 Req | ——— | Set Screw, Allen Hex, 4-40 x 1/8 | ——— | ——— |

*Table 6-15. Parts List — 1210 Vertical Board Sub-Assembly (12105032)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12103032 | Etched Circuit Bd | 34160 | 1-20060 |
| ——— | 12103036 | Etched Circuit Bd | 34160 | 1-20083 |
| | | CAPACITORS | | |
| C1 | ZA2C104 | Met,Myl,.1uf ±20%,200V | 27556 | 6-47104 |
| C2 | ZA2C104 | Met,Myl.,.1uf ±20%,200V | 27556 | 6-47104 |
| C3 | DM15-220J | DM, 22pf ±5%, 500V | 04062 | 6-19220 |
| C4 | DM15-391J | DM, 390pf ±5%, 500V | 04062 | 6-19391 |
| C5 | C4002/1B | Var, 1.5-20pf | 84171 | 6-96005 |
| C6 | DM15-820J | DM,82pf ±5%, 500V | 04062 | 6-19820 |
| C7 | UK20-104 | CD,.1uf+80%–20%,20V | 71590 | 6-24104 |
| C8 | DM15-680J | DM,68pf ±5%, 500V | 04062 | 6-19680 |
| C9 | UK20-104 | CD,.1uf+80%–20%, 20V | 71590 | 6-24104 |
| C10 | UK20-104 | CD,.1uf+80%–20%, 20V | 71590 | 6-24104 |
| C11 | UK20-104 | CD,.1uf+80%–20%, 20V | 71590 | 6-24104 |
| C12 | T362C476M 020AS | Tant, 47uf ±20%, 20V | 05397 | 6-74476 |
| C13 | T362C476M 020AS | Tant, 47uf ±20%, 20V | 05397 | 6-74476 |
| | | DIODES | | |
| CR1 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR2 | 1N914 | GP, Signal | 07263 | 3-10914 |
| CR3 | 1N914 | GP, Signal | 07263 | 3-10914 |
| | | INTEGRATED CIRCUITS | | |
| U1 | FD1673 | FET, Dual N | 22229 | 3-21673 |
| U2 | CA3046 | Array | 18722 | 3-33046 |
| U3 | CA3036 | Array | 18722 | 3-33036 |
| | | RESISTORS | | |
| R1 | 360T502B | Var, Cer, 5Kohm | 71450 | 5-73502 |
| R2 | RCR07G180JR | CC,180 ohm, ¼W, 5% | 01121 | 5-10181 |
| R3 | RN60D6653F | MF,665Kohm, 1/8W,1% | 91637 | 5-50473 |
| R4 | RN60D3323F | MF,332Kohm, 1/8W,1% | 91637 | 5-50444 |
| R5 | RCR07G101JR | CC,100ohm, ¼W, 5% | 01121 | 5-10101 |
| R6 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |
| R7 | RCR07G121JR | CC,120ohm, ¼W, 5% | 01121 | 5-10121 |
| R8 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |
| R9 | RCR07G622JR | CC,6.2Kohm, ¼W, 5% | 01121 | 5-10622 |
| R10 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R11 | RCR07G121JR | CC,120ohm, ¼W, 5% | 01121 | 5-10121 |
| R12 | RCR07G471JR | CC,470ohm, ¼W, 5% | 01121 | 5-10471 |
| R13 | RCR07G392JR | CC,3.9Kohm, ¼W, 5% | 01121 | 5-10392 |

*Table 6-15. Parts List — 1210 Vertical Board Sub-Assembly (12105032) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R14 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R15 | 360T502B | Var, Cer, 5Kohm | 71450 | 5-73502 |
| R16 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R17 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R18 | RCR07G102JR | CC,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R19 | RCR07G271JR | CC,270ohm, ¼W, 5% | 01121 | 5-10271 |
| R20 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R21 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R22 | RCR07G822JR | CC,8.2Kohm, ¼W, 5% | 01121 | 5-10822 |
| R23 | RCR07G104JR | CC,100Kohm, ¼W, 5% | 01121 | 5-10104 |
| R24 | RCR07G101JR | CC,100ohm, ¼W, 5% | 01121 | 5-10101 |
| R25 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R26 | RCR07G100JR | CC,10ohm, ¼W, 5% | 01121 | 5-10100 |
| R201 | 3006P-1-502 | Var, Cer, 5Kohm | Bourns | 5-79502 |
| R202 | 3006P-1-502 | Var, Cer, 5Kohm | Bourns | 5-79502 |
| | | SWITCHES | | |
| S1 | 12M965 | Coupling Switch | 01121 | 2-10043 |
| S2 | 12012067 | Rotary 4 Pol, 5Pos | 34160 | 2-10039 |
| | | TRANSISTOR | | |
| Q1 | 2N3694 | NPN, Signal | 07263 | 3-23694 |
| | | HARDWARE | | |
| Item 87 | 180 | Coupler, Shaft 1/8" | 83330 | 4-20003 |
| Item 88 | MP170-2 | Terminal,Mini-Pin, .6L | PMP | 2-24015 |
| 5 Req | 02-005-013-5-200 | Elco Pins | Elco | 2-29994 |
| Item 91 | 120 | Coupler, Shaft ¼" | 83330 | 4-20204 |

*Table 6-16. Parts List — Chassis Assembly (12015003)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12015009 | Interconnect Sub-Assy | 34160 | ————— |
| ——— | 12015013 | Chassis Frame Sub-Assy | 34160 | ————— |
| ——— | 12012006 | Cover-Power Supply | 34160 | 1-10327 |
| ——— | 12012003 | Track-Center | 34160 | 1-10325 |
| ——— | 12012020 | Shaft-Switch | 34160 | 4-20104 |
| ——— | 12012035 | Coupler-Switch | 34160 | 1-10230 |
| ——— | 12012030 | Shield-Light | 34160 | 1-10227 |
| ——— | 12012019-2 | Bracket, Rack Mnt-L.H. | 34160 | 1-10229 |
| ——— | 12012019-1 | Bracket, Rack Mnt-R.H. | 34160 | 1-10228 |
| ——— | 12012053 | Support Bracket | 34160 | 1-10338 |
| 12 Req | ————— | Screw, 100° Flat, 4-40 x 1/8 | ——— | ————— |
| 26 Req | MS24693-2 | Screw, 100° Flat, 4-40x¼ | ——— | ————— |
| 9 Req | MS24693-6 | Screw, 100° Flat, 4-40x½ | ——— | ————— |
| 4 Req | MS24693-46 | Screw, 100° Flat, 8-32x¼ | ——— | ————— |
| 5 Req | MS51957-17 | Screw, Pan, 4-40x½ | ——— | ————— |
| 1 Req | MS35649-44 | Nut, 4-40 | ——— | ————— |

*Table 6-17. Parts List — Master Board Sub-Assembly (12015005)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12013002 | Etched Circuit Board | 34160 | 1-20030 |
| ——— | 12012011 | Chassis Support | 34160 | 1-10220 |
| ——— | 12012008 | Support-Master Board | 34160 | 1-10219 |
| | | CAPACITORS | | |
| C1 | ZA4470 | Cap,MM,.1uf ±20%,1.5KV | 27556 | 6-40104 |
| | | DIODES | | |
| CR1 | 1N969B | Diode, 1N969B | 07263 | 3-10969 |
| | | LAMPS | | |
| DS1 | 186 | T-1/2 Lamp | Illuminated Products Inc. | 3-50009 |
| | | CONNECTORS | | |
| J1 | 143-012-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J2 | 143-013-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J3 | 143-102-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J4 | 143-012-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J5 | 143-012-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J6 | 143-012-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J7 | 143-012-03 | Connector, 12 Pin | Amphenol | 2-23999 |
| J8 | 12012044 | Connector, 12 Pin Modified | 34160 | 2-24001 |
| J9 | 12012044 | Connector, 12 Pin Modified | 34160 | 2-24001 |
| | | RESISTORS | | |
| R1 | RCR07G181JR | Res,CC,180ohm,¼W,5% | 01121 | 5-10181 |
| | | SWITCHES | | |
| S2 | 46206LFR, P.C. Term | Switch, Slide, P.C. Term 115/230 | Switch Craft | 2-10025 |
| 2 Req | 2000C | Terminal, Bifurcated | Useco | ——— |
| 3 Req | 2970-01-93 | Terminal | Cambion | 2-23998 |
| 8 Req | MS51957-14 | Screw, Panhead 4-40 x 5/16 | ——— | ——— |
| 8 Req | MS35333-70 | Washer, Internal Lk,No. 4 | ——— | ——— |

*Table 6-18. Parts List — PC Sub-Assembly, Low Voltage (12015006)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12013003 | Printed Wiring Board | 34160 | 1-20031 |
| | | INTEGRATED CIRCUITS | | |
| U1 | LM305 | I.C. Reg. LM305 | Nat'l | 3-30305 |
| U2 | LM305 | I.C. Reg. LM305 | Nat'l | 3-30305 |
| U3 | LM301A | I.C. AMP LM301A | Nat'l | 3-30301 |
| | | CAPACITORS | | |
| C1 | WBR-1000-16 | Cap,Elect,1000uf,16V | Cornell-Dubilier | 6-84108 |
| C2 | DM15470J | Cap,DM,47pf, 500V | 00853 | 6-19470 |
| C3 | K68E15 | Cap,Tant, 68uf, 15V | 05397 | 6-74686 |
| C4 | WBR-1000-16 | Cap,Elect,1000uf,16V | Cornell-Dubilier | 6-84108 |
| C5 | DM15470J | Cap,DM, 47pf, 500V | 00853 | 6-19470 |
| C6 | K220E10 | Cap, Tant, 220uf, 10V | 05397 | 6-76227 |
| C7 | 39D506F150 FJ4 | Cap,Elect,50uf,150V | 56289 | 6-87256 |
| C8 | DM15470J | Cap, DM, 47pf, 500V | 00853 | 6-19470 |
| C9 | K68E15 | Cap, Tant, 68uf, 15V | 05397 | 6-74686 |
| C10 | CM05FD471 J03 | Cap, DM, 470pf, 500V | 00853 | 6-19471 |
| C11 | ZD2A105K | Cap,Myl,1uf,200V,10% | 14752 | 6-47105 |
| | | DIODES | | |
| CR1 | 1N914 | Diode | Jedec | 3-10914 |
| CR2 a-d* | 1N4004 | Diode, Power, 1A, 400V | 07263 | 3-14004 |
| CR3 | 1N914 | Diode | Jedec | 3-10914 |
| CR4 a-d* | 1N4004 | Diode, Power, 1A, 400V | 07263 | 3-14004 |
| CR5 a-d* | 1N4004 | Diode, Power, 1A, 400V | 07263 | 3-14004 |
| CR6 | 1N914 | Diode | Jedec | 3-10914 |
| CR7 | 1N914 | Diode | Jedec | 3-10914 |
| CR8 | 1N750A | Diode, Zener | Jedec | 3-10750 |
| | | RESISTORS | | |
| R1 | RC07GF3R3J | Res,CC,3.3ohm,¼W,5% | 01121 | 5-103R3 |
| R2 | RC07GF122J | Res,CC,1.2Kohm,¼W,5% | 01121 | 5-10122 |
| R3 | RC20GF1R0J | Res,CC,1ohm,½W,5% | 78488 | 5-20010 |
| R4 | RC07GF121J | Res,CC,120ohm,¼W,5% | 01121 | 5-10121 |
| R5 | RC07GF103J | Res,CC,10Kohm,¼W,5% | 01121 | 5-10103 |
| R6 | 360T-202B | Res,Var, 2Kohm | 71450 | 5-73202 |
| R7 | RC07GF222J | Res,CC,2.2Kohm,¼W,5% | 01121 | 5-10222 |
| R8 | RC07GF3R3J | Res,CC,3.3ohm,¼W,5% | 01121 | 5-103R3 |
| R9 | RC07GF122J | Res,CC,1.2Kohm,¼W,5% | 01121 | 5-10122 |

*Only acceptable manufacturer is Fairchild

*Table 6-18. Parts List – PC Sub-Assembly, Low Voltage (12015006) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R10 | RC20GF1R0J | Res,CC,1ohm,½W,5% | 78488 | 5-20010 |
| R11 | RC07GF121J | Res,CC,120ohm,¼W,5% | 01121 | 5-10121 |
| R12 | RC07GF103J | Res,CC,10Kohm,¼W,5% | 01121 | 5-10103 |
| R13 | 360T-202B | Res,Var, 2Kohm | 71450 | 5-73202 |
| R14 | RC07GF222J | Res,CC,2.2Kohm,¼W,5% | 01121 | 5-10222 |
| R15 | RC07GF154J | Res,CC,150Kohm,¼W,5% | 01121 | 5-10154 |
| R16 | RC07GF471J | Res,CC,470ohm,¼W,5% | 01121 | 5-10471 |
| R17 | RC07GF124J | Res,CC,120Kohm,¼W,5% | 01121 | 5-10124 |
| R18 | RC07GF242J | Res,CC,2.4Kohm,¼W,5% | 01121 | 5-10242 |
| R19 | RC07GF120J | Res,CC,10ohm,¼W,5% | 01121 | 5-10100 |
| R20 | RC07GF821J | Res,CC,820ohm,¼W,5% | 01121 | 5-10821 |
| R21 | RN60D1004F | Res,MF,1Mohm,1/8W,1% | 91637 | 5-50490 |
| R22 | 360T-253B | Res,Var, 25Kohm | 71450 | 5-73253 |
| R23 | RN55D2552F | Res,MF,25.5Kohm,1/8W, 1% | 91637 | 5-51338 |
| R24 | RN60D1004F | Res,MF,1Mohm,1/8W,1% | 91637 | 5-50490 |
| | | TRANSISTORS | | |
| Q1 | D45-C8B | Tran,PNP,D45-C8B | GE | 3-245C8 |
| Q2 | 2N4250 | Tran,NPN,2N4250 | Jedec | 3-24250 |
| Q3 | D45-C8B | Tran,PNP,D45-C8B | GE | 3-245C8 |
| Q4 | 2N4250 | Tran,NPN,2N4250 | Jedec | 3-24250 |
| Q5 | 2N4250 | Tran,NPN,2N4250 | Jedec | 3-24250 |
| Q6 | 2N6211 | Tran,PNP,2N6211 | Jedec | 3-26211 |
| 1 Req | 12012046 | Heatsink | 34160 | 1-10226 |
| 1 Req | 2022004 | Handle | 34160 | 4-10002 |
| 2 Req | DF-103C | Mica Insulator | 86684 | ----- |
| 2 Req | DF-137A | Washer-Insulating | 86684 | ----- |

*Table 6-19. Parts List — PC Sub-Assembly, High Voltage (12015007)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12013004 | Printed Wiring Board | 34160 | 1-20027 |
| | | INTEGRATED CIRCUIT | | |
| U1 | LM301A | Amp,Integrated Circuit | Nat'l | 3-30301 |
| | | CAPACITORS | | |
| C1 | ZDA7323 | Cap,Myl.,1uf,1500V | 14752 | 6-49106 |
| C2 | ZDA7323 | Cap,Myl.,1uf,1500V | 14752 | 6-49106 |
| C3 | 19FD102J03 | Cap,Mica,1000pf,500V | 00853 | 6-19102 |
| C4 | 601D357G050 GJ4 | Cap,Elect,350uf,50V | 56289 | 6-86337 |
| C5 | K4R7E50 | Cap,Tant,4.7uf,50V | 05397 | 6-76475 |
| C6 | 30GA-S10 | Cap, CD, .01uf, 3KV | 56289 | 6-29104 |
| C7 | ZA2B472 | Cap,Myl.,.0047uf,100V | IMB | 6-47472 |
| C8 | 30GA-T-39 | Cap,390pf, 3KV, 10% | 71590 | 6-29391 |
| | | DIODES | | |
| CR1 | EJ350 | Diode, H.V. EJ350 | 14099 | 3-10350 |
| CR2 | EJ350 | Diode, H.V. EJ350 | 14099 | 3-10350 |
| CR3 a-d* | 1N4004 | Diode, Power, 1A, 400V | 07263 | 3-14004 |
| CR4 | 1N914 | Diode 1N914 | Jedec | 3-10914 |
| CR5 | 1N914 | Diode 1N914 | Jedec | 3-10914 |
| CR6 | 1N914 | Diode 1N914 | Jedec | 3-10914 |
| CR7 | 1N969A | Diode, Zener 1N969A | Jedec | 3-10969 |
| CR8 | 1N969A | Diode, Zener 1N969A | Jedec | 3-10969 |
| | | RESISTORS | | |
| R1 | RC20GF474J | Res,470Kohm, ½W, 5% | 01121 | 5-20474 |
| R2 | RC20GF474J | Res,470Kohm, ½W, 5% | 01121 | 5-20474 |
| R3 | RC20GF474J | Res,470Kohm, ½W, 5% | 01121 | 5-20474 |
| R4 | RC20GF474J | Res,470Kohm, ½W, 5% | 01121 | 5-20474 |
| R5 | RC20GF474J | Res,470Kohm, ½W, 5% | 01121 | 5-20474 |
| R6 | RC20GF474J | Res,470Kohm, ½W, 5% | 01121 | 5-20474 |
| R7 | RC07GF561J | Res,560ohm, ¼W, 5% | 01121 | 5-10561 |
| R8 | RC07GF123J | Res,12Kohm, ¼W, 5% | 01121 | 5-10123 |
| R9 | RN55D3921F | Res,3.92Kohm,1/8W,1% | 91637 | 5-51250 |
| R10 | RC07GF222J | Res,2.2Kohm, ¼W, 5% | 01121 | 5-10222 |
| R11 | RC07GF102J | Res,1Kohm, ¼W, 5% | 01121 | 5-10102 |
| R12 | RN55D3922F | Res,39.2Kohm,1/8W,1% | 91637 | 5-51356 |
| R13 | PME75 | Res,10Mohm, 2W, 1% | ——— | 5-59001 |
| R14 | RC07GF103J | Res,10Kohm, ¼W, 5% | 01121 | 5-10103 |
| R15 | RC07GF330J | Res,33ohm, ¼W, 5% | 01121 | 5-10330 |
| R16 | RC07GF471J | Res,470ohm, ¼W, 5% | 01121 | 5-10471 |

*Only acceptable manufacturer is Fairchild

*Table 6-19. Parts List – PC Sub-Assembly, High Voltage (12015007) (Continued)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| R17 | RC07GF473J | Res,47Kohm, ¼W, 5% | 01121 | 5-10473 |
| | | TRANSISTORS | | |
| Q1 | D40N4 | Transistor | GE | 3-240N4 |
| Q2 | D40N4 | Transistor | GE | 3-240N4 |
| Q3 | D40N4 | Transistor | GE | 3-240N4 |
| Q4 | D40N4 | Transistor | GE | 3-240N4 |
| Q5 | D40N4 | Transistor | GE | 3-240N4 |
| Q6 | D40N4 | Transistor | GE | 3-240N4 |
| Q7 | 2N3694 | Transistor | Jedec | 3-24694 |
| Q8 | 2N4250 | Transistor | Jedec | 3-24250 |
| Q9 | 2N3739 | Transistor | Jedec | 3-23739 |
| Q10 | 2N3694 | Transistor | Jedec | 3-23694 |
| Q11 | 2N3694 | Transistor | Jedec | 3-23694 |
| 1 Req | 2022004 | Handle | 34160 | 4-10002 |

*Table 6-20. Parts List — Connector Board Sub-Assembly (12015008)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ---- | 12013007 | Etch Circuit Board | 34160 | 1-20053 |
| R1 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R2 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R3 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R4 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R5 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R6 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R7 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R8 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R9 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R10 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R11 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R12 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R13 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R14 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R15 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R16 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R17 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R18 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R19 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R20 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| R21 | RC07GF226J | Res,22Meg, ¼W, ±5% | 01121 | 5-10226 |
| 28 Req | 17-763-02 | Connector Pin | Amphenol | 2-24002 |

*Table 6-21. Parts List — Interconnect Sub-Assembly (12015009)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| --- | 12015010 | Rear Panel Sub Assy. | 34160 | ----- |
| --- | 12015008 | Connector Bd. Sub Assy | 34160 | ----- |
| --- | 12015005 | Master Bd. Sub Assy | 34160 | ----- |
| --- | 12012009 | Chassis-Power Supply | 34160 | 1-10232 |
| T1 | 12012028 | Transformer, Power | 34160 | 7-61007 |
| --- | 12012045 | Spacer-Circuit Bd. | 34160 | 1-10231 |
| 4 Req | 8706 | Spacer No. 4 Clearance x .313 long | 83330 | 4-20105 |
| 2 Req | 2342 | Spacer No. 4 Clearance x .500 long | 83330 | 4-20106 |
| S1 | 1XF1252UEE | Power Switch | IEE | 2-10019 |
| 4 Req | MS24693-7 | Screw, 100° Flat, 4-40 x 5/8 | --- | ----- |
| 1 Req | MS24693-2 | Screw, 100° Flat, 4-40x¼ | --- | ----- |
| 2 Req | MS51957-19 | Screw, Panhead, 4-40x¾ | --- | ----- |
| 4 Req | MS51957-15 | Screw, Panhead, 4-40 x 3/8 | --- | ----- |
| 4 Req | MS51957-43 | Screw, Panhead, 8-32 x 3/8 | --- | ----- |
| 11 Req | MS35333-70 | Washer, No. 4 Int Lk | --- | ----- |
| 4 Req | MS35333-72 | Washer, No. 8 Int. Lk | --- | ----- |
| 4 Req | MS35649-44 | Nut, 4-40 | --- | ----- |

*Table 6-22. Parts List — Rear Panel Sub-Assembly (12015010)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ---- | 12012033-1 | Panel-Rear | 34160 | 1-10221 |
| | | CONNECTORS | | |
| J101-1 | UG1094/u | Connector, BNC | --- | 2-28998 |
| J101-2 | UG1094/u | Connector, BNC | --- | 2-28998 |
| J101-3 | UG1094/u | Connector, BNC | --- | 2-28998 |
| J107-1 | UG1094/u | Connector, BNC | --- | 2-28998 |
| J017-2 | UG1094/u | Connector, BNC | --- | 2-28998 |
| J107-3 (21 Req.) | UG1094/u | Connector, BNC | --- | 2-28998 |
| 1 Req | 17405B | Power Cord | Belden | 2-70000 |
| X1 | 342004 | Fuse Holder | 75915 | 2-40000 |
| 1 Req | 6P3-4 | Strain Relief Bushing | 28520 | 2-45000 |
| F1 | 3AG/A SB | Fuse, 1 Amp, SB | Littlefuse | 2-40003 |
| 14 Req | 212-110302-00 | Grommet, Insulator | Fastex | ----- |

*Table 6-23. Parts List — Chassis Frame Sub-Assembly (12015013)*

| REFERENCE DESIGNATOR | MANUFACTURER PART NUMBER | DESCRIPTION | MANU-FACTURER | DATA CHECK PART NO. |
|---|---|---|---|---|
| ——— | 12012004 | Cover-Bottom | 34160 | 1-10328 |
| ——— | 12012002 | Track-Right Hand | 34160 | 1-10326 |
| ——— | 12012005 | Cover-Top | 34160 | 1-10329 |
| ——— | 12012029 | Side Panel — Left | 34160 | 1-10233 |
| ——— | 12012001 | Track — Left Side | 34160 | 1-10235 |
| 6 Req | MS51957-12 | 4-40 x 3/16 Panhead Screw | ——— | ——— |
| 3 Req | MS24693-1 | 4-40 x 3/16 100° Flathead | ——— | ——— |
| 3 Req | MS24693-2 | 4-40 x 1/4 100° Flathead | ——— | ——— |

# SECTION VII

# DRAWINGS

List of Drawings:

Figure 7-1. Schematic – Power Supply – 12001001
Figure 7-2. Schematic – 1220 Oscilloscope Module – 12001020
Figure 7-3. Schematic – 1210 Oscilloscope Module – 12001021
Figure 7-4. Wiring Interconnect – 12001005
Figure 7-5. Wiring Diagram – 1220 – 12001022
Figure 7-6. Wiring Diagram – 1210 – 12001023

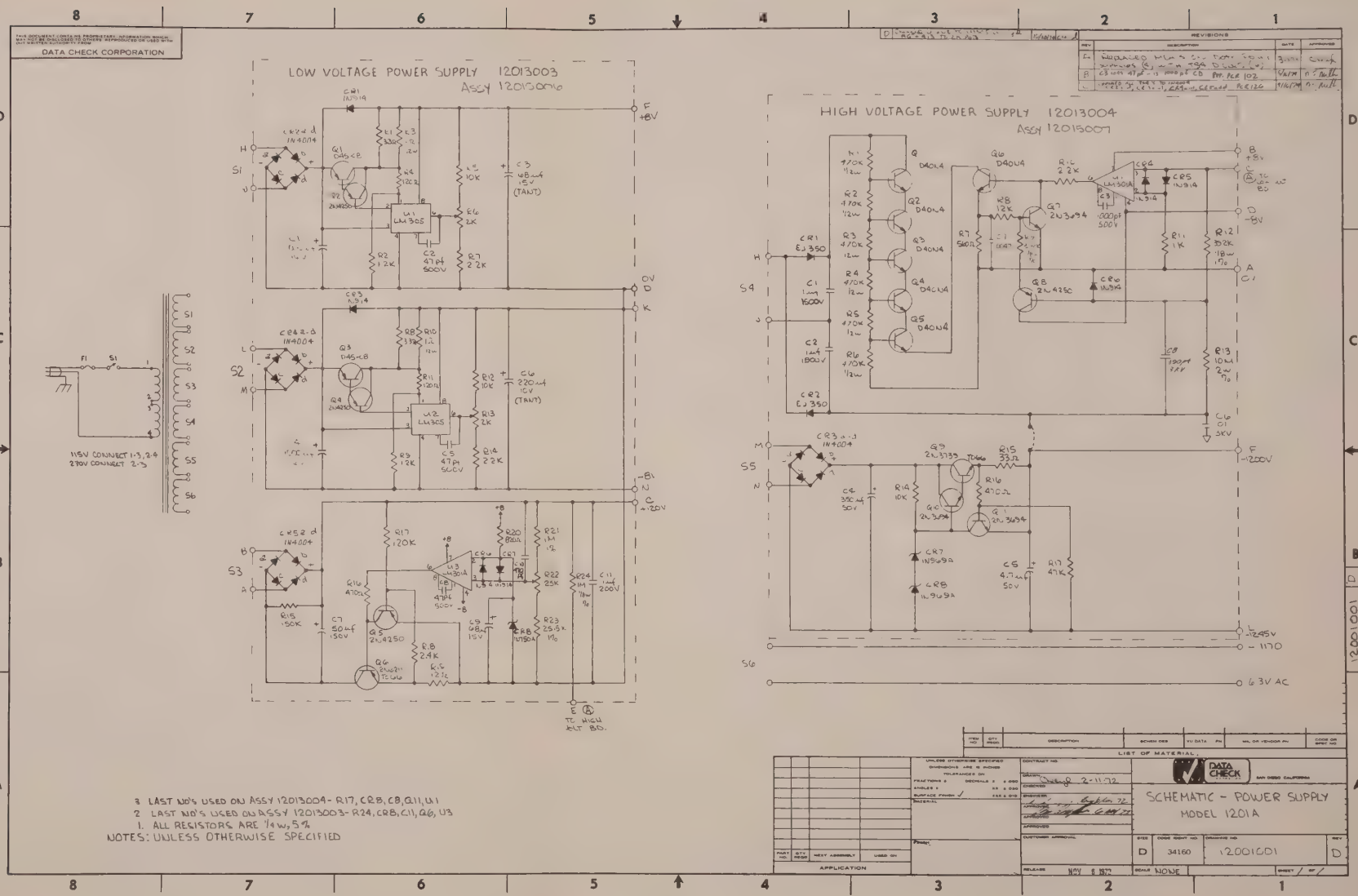

DATA CHECK CORPORATION
LOW VOLTAGE POWER SUPPLY 12013003
ASSY 12013006
HIGH VOLTAGE POWER SUPPLY 12013004
ASSY 12013007
115V CONNECT 1-3, 2-4
230V CONNECT 2-3
SCHEMATIC - POWER SUPPLY
MODEL 1201A
12001601
3 LAST NO'S USED ON ASSY 12013004 - R17, CR8, C8, Q11, U1
2 LAST NO'S USED ON ASSY 12013003 - R24, CR8, C11, Q6, U3
1. ALL RESISTORS ARE 1/4 W, 5%
NOTES: UNLESS OTHERWISE SPECIFIED

*Figure 7-1. Power Supply Schematic*

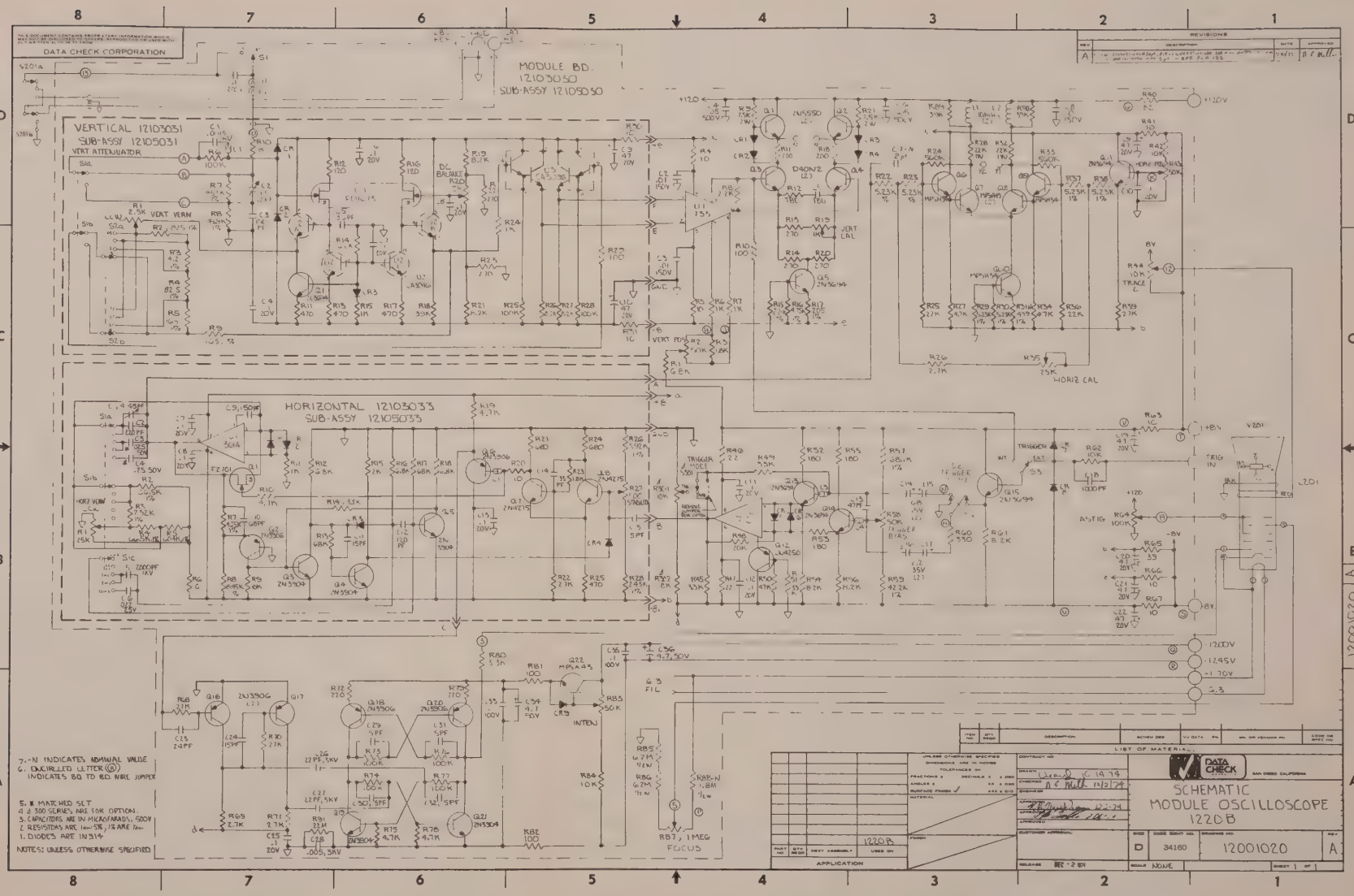



*Figure 7-2. 1220 Oscilloscope Module Schematic*

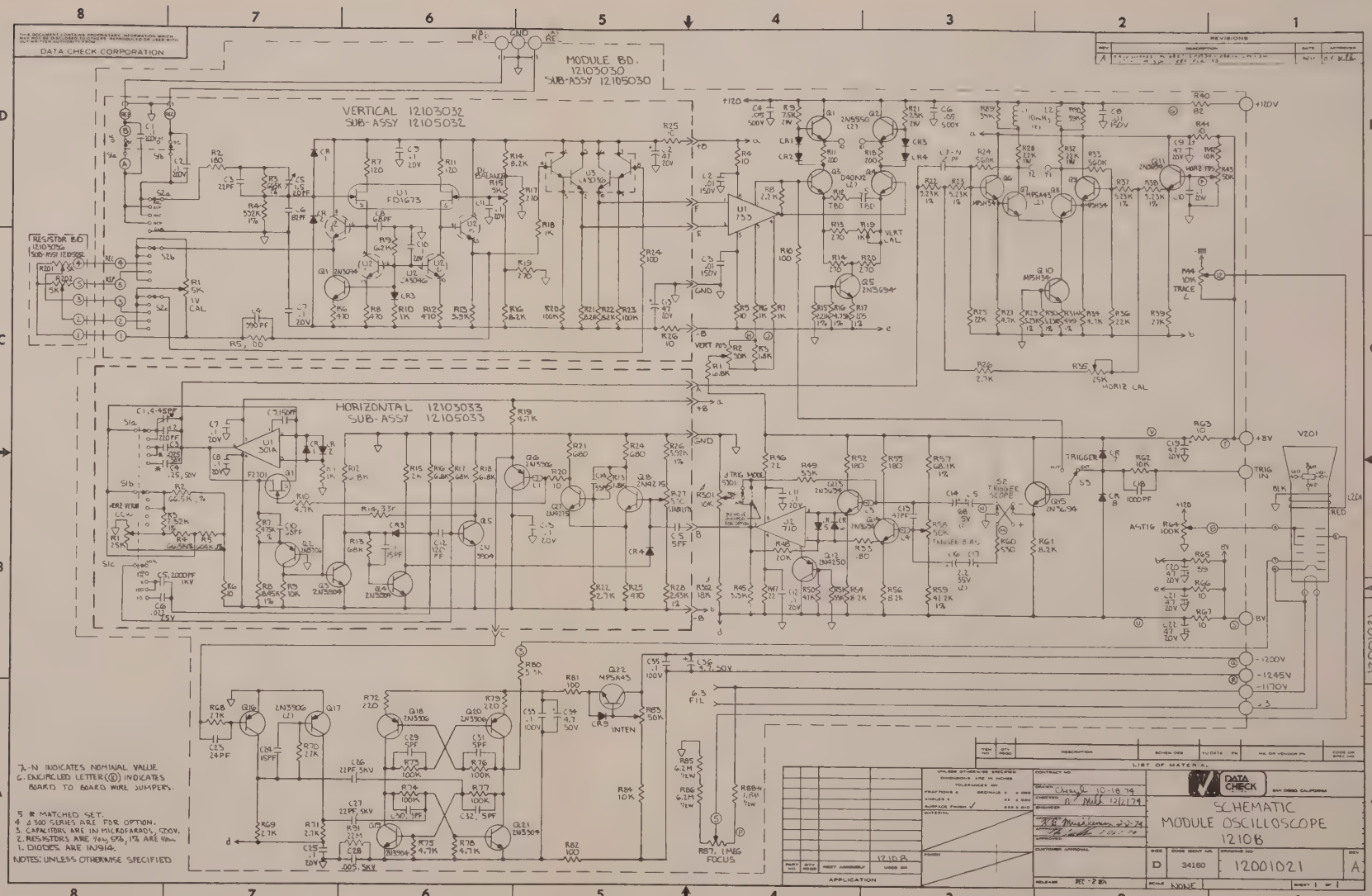



*Figure 7-3. 1210 Oscilloscope Module Schematic*

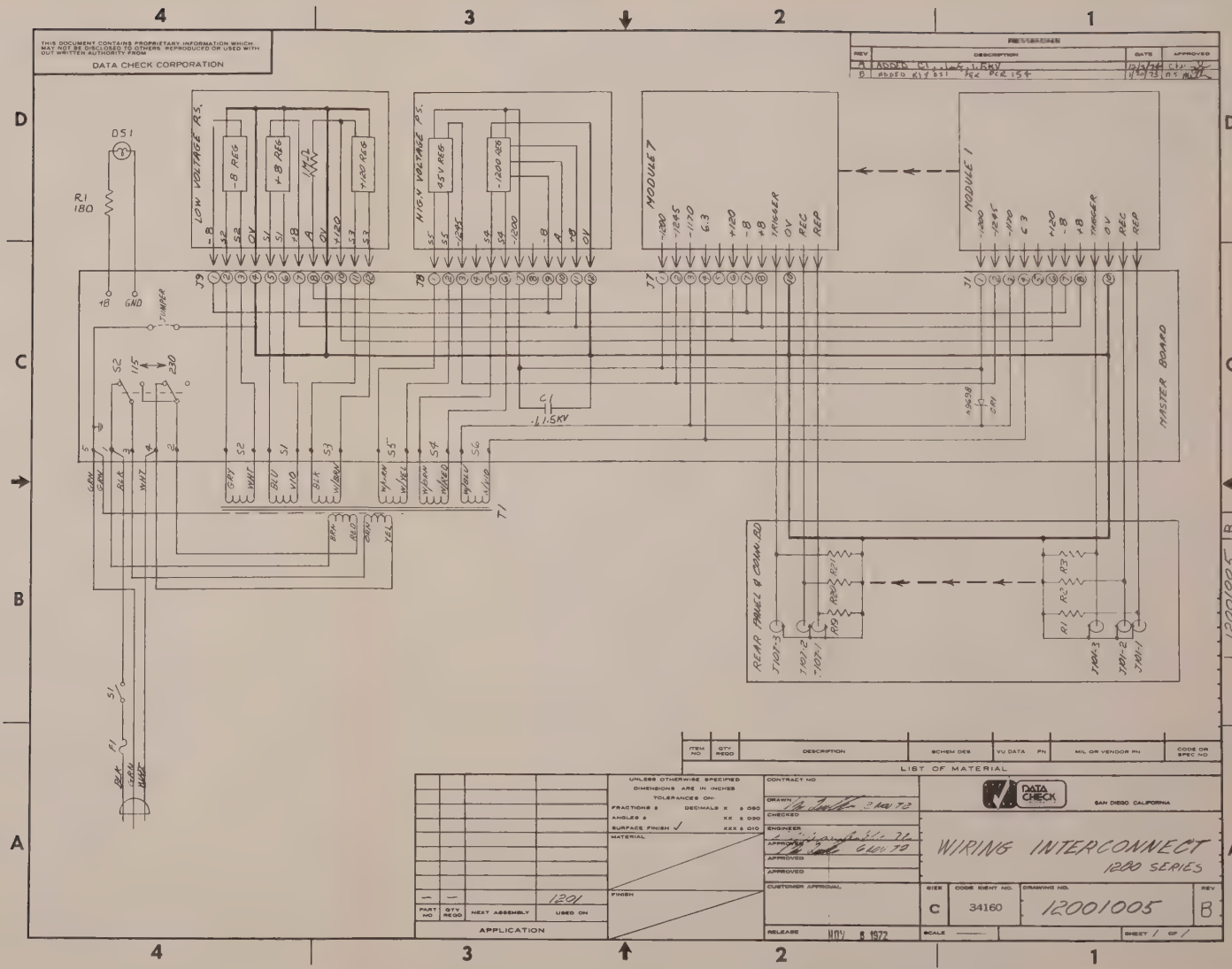



*Figure 7-4. Master Wiring Interconnect*

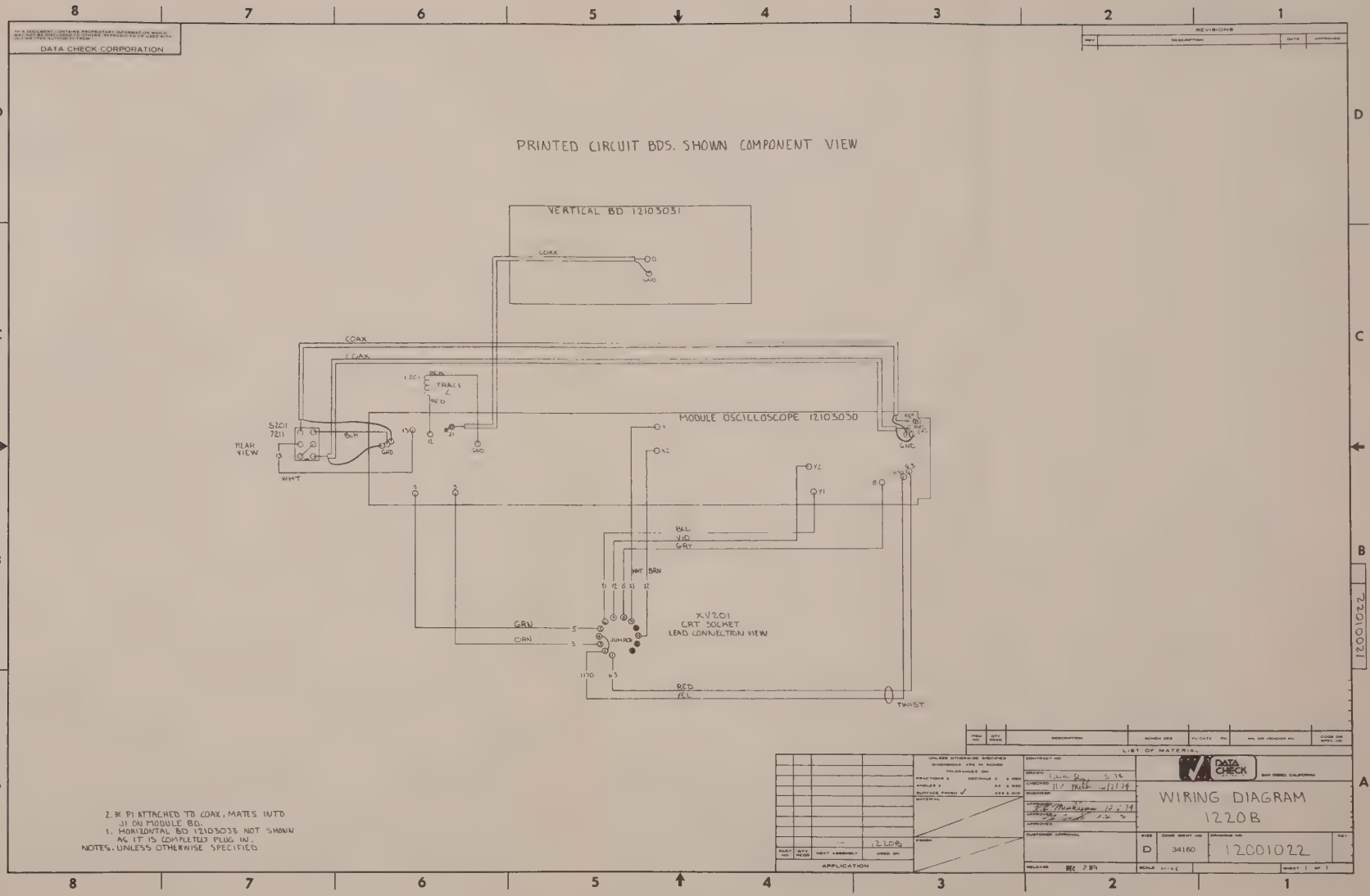



*Figure 7-5. 1220 Wiring Diagram*

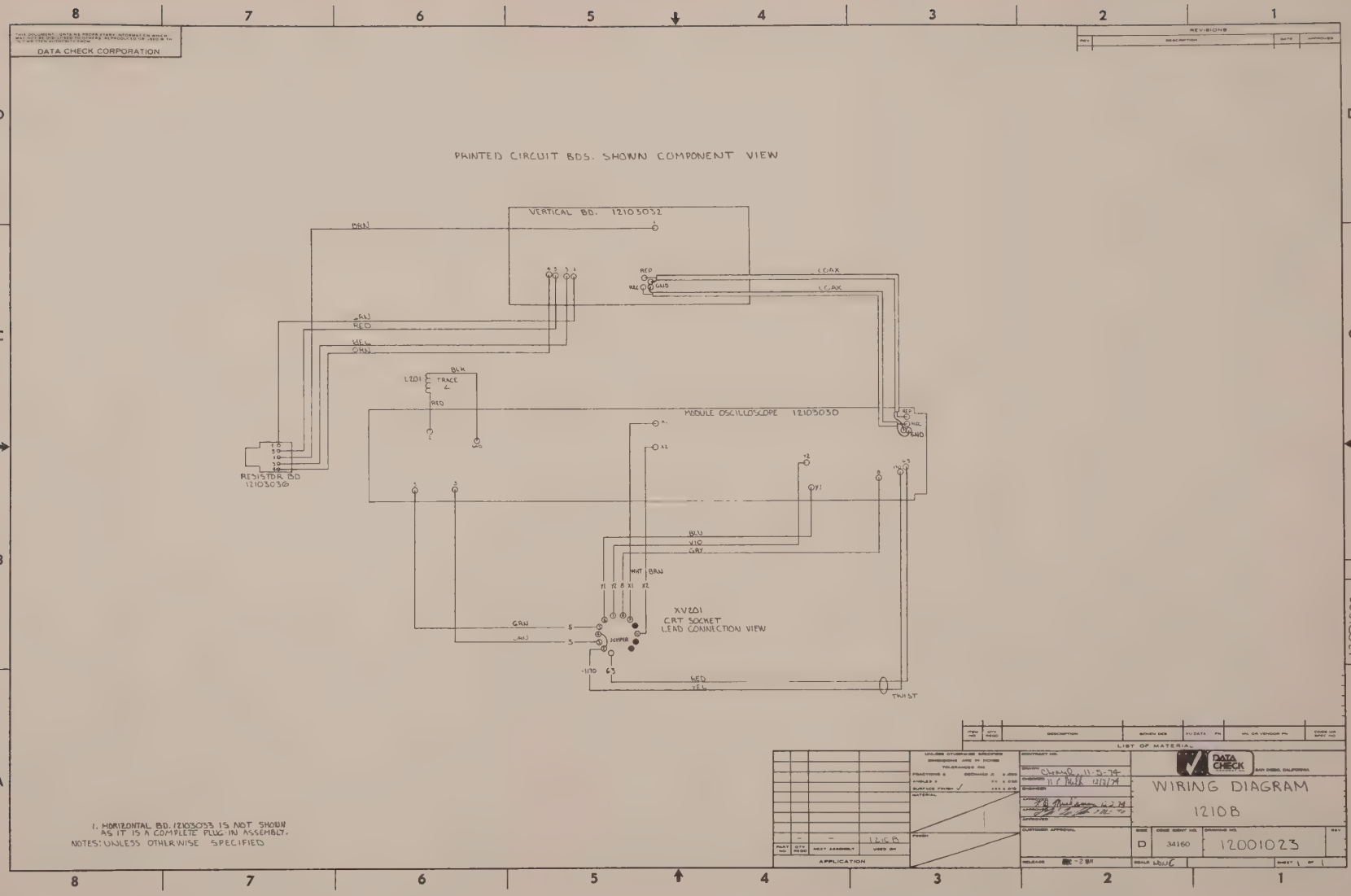



*Figure 7-6. 1210 Wiring Diagram*

# SECTION VIII

# RECOMMENDED SPARES

The following is a list of recommended spare parts required to maintain a specific number of instrument at a satisfactory level of performance for one year in an isolated area.

| *ASSEMBLY OR PART NAME* | | DATA CHECK *PART NUMBER* | *QUANTITY OF PARTS* *1 INST.* | *5 INST.* | *10 INST.* |
|---|---|---|---|---|---|
| CRT | | 3-40002 | 1 | 2 | 3 |
| Integrated Circuit | LM301A | 3-30301 | 1 | 2 | 3 |
| Integrated Circuit | MC1710CG | 3-30710 | 1 | 2 | 3 |
| Integrated Circuit | uA733HC | 3-30733 | 1 | 2 | 3 |
| Integrated Circuit | CA3036 | 3-33036 | 1 | 2 | 3 |
| Integrated Circuit | CA3046 | 3-33046 | 1 | 2 | 3 |
| Transistor | 2N3694 | 3-23694 | 3 | 5 | 10 |
| Transistor | 2N4250 | 3-24250 | 1 | 3 | 5 |
| Transistor | 2N4275 | 3-24275 | 2 | 3 | 5 |
| Dual FET Transistor | FD1673 | 3-21673 | 3 | 5 | 10 |
| FET Transistor | F2701 | 3-21837 | 2 | 4 | 5 |
| Transistor | 2N3904 | 3-23904 | 3 | 5 | 10 |
| Transistor | 2N3906 | 3-23906 | 3 | 5 | 10 |
| Transistor | MPSA43 | 3-20043 | 2 | 3 | 5 |
| Transistor | 2N5550 | 3-25550 | 2 | 3 | 4 |
| Transistor | D40N2 | 3-240N2 | 2 | 2 | 2 |
| Low Voltage P.S. | | 12015006 | 1 | 1 | 2 |
| High Voltage P.S. | | 12015007 | 1 | 1 | 2 |
| 1210 Vertical Sub-Assembly | | 12105032 | 2 | 3 | 4 |
| 1220 Vertical Sub-Assembly | | 12105031 | 2 | 3 | 4 |
| Horizontal Sub-Assembly | | 12105033 | 3 | 5 | 7 |
| Fuse 3AG/ASB | | 2-40003 | 1 | 1 | 2 |

*Table 8-1. Recommended Spare Parts*